

**GTE Command Reference**

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Version 1.0

Sony Computer Entertainment Inc.

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**Limiters:**

During some calculation processing, calculation results, data values in registers, etc., are clipped when they exceed specified upper limit and lower limit values. In other words, data values lower than the lower limit value are converted to the lower limit value, and data values higher than the upper limit value are converted to the upper limit value. Also, the occurrence of such conversions is reflected in out-of-bounds data detection flags in the FLAG register. These functions are referred to as "limters."

The usage of the various limters and the codes used to specify them in this documentation are listed below.

**Calculation error detection:**

Overflow and underflow detection are performed only for certain specific calculation operations. In this documentation, the calculation test result flag number is listed between angle brackets < > to the right of calculation operations that are subject to such detection.

Code	Limiter	Out-of-bounds detect bit	Lower limit	Upper limit	Comments
A1S	A1	24	-2 <sup>15</sup> 15	2 <sup>15</sup> 1-1	
A2S	A2	23	-2 <sup>15</sup> 15	2 <sup>15</sup> 1-1	
A3S	A3	22	-2 <sup>15</sup> 15	2 <sup>15</sup> 1-1	
A1U	A1	24	0	2 <sup>15</sup> 1-1	
A2U	A2	23	0	2 <sup>15</sup> 1-1	
A3U	A3	22	0	2 <sup>15</sup> 1-1	
A1C	A1	24	0 or -2 <sup>15</sup>	2 <sup>15</sup> 1-1	Lower limit val is specified using lim argument.
A2C	A3	23	0 or -2 <sup>15</sup>	2 <sup>15</sup> 1-1	Lower limit val is specified using lim argument.
A3C	A3	22	0 or -2 <sup>15</sup>	2 <sup>15</sup> 1-1	Lower limit val is specified using lim argument.
B1	B1	21	0	2 <sup>8</sup> -1	
B2	B2	20	0	2 <sup>8</sup> -1	
B3	B3	19	0	2 <sup>8</sup> -1	
C	C	18	0	2 <sup>16</sup> -1	
D1	D1	14	-2 <sup>10</sup> 0	2 <sup>10</sup> -1	
D2	D2	13	-2 <sup>10</sup> 0	2 <sup>10</sup> -1	
E	E	12	0	2 <sup>12</sup> -1	

**Explanation:**

Character attributes	Example	Content
<b>Underline</b>	<b>VAL</b>	Intermediate value (No corresponding register)
Emphasis character	<b>OBJ</b>	32-bit value

**Descriptor examples:**

(A)  $A = B;$   
-->  $A=B$  is executed for the fixed-point expression (1.15.0).

(B)  
(1.15.0)  $IR0 = \text{limX}(SSX);$

Limiter:		
Code	Lower limit	Upper limit
<b>limX</b>	$-2^{15}$	$2^{15}-1$

--> The 32-bit value SSX is rounded using the limiter specified by X. The fixed-point expression (1.12.0) representing the results obtained is substituted for IR1.

(C)

$n=0,1,2\{$

(1.3.12)  $L1n$

=  $\text{limA}(LL1n);$

}

--> For the fixed-point expression (1.3.12), the following are executed:

$L10 = \text{limA}(L1.10);$   
 $L11 = \text{limA}(LL11);$   
 $L12 = \text{limA}(LL12);$

(D)

$sf==0$        $sf==1$   
(1.31.0) (1.19.12)  $A = B;$

--> B is substituted for A. However, the value is converted into a 32-bit signed fixed-point number with no fractional part if sf is 0, and with a 12-bit fraction if sf is 1.

**Command list:**

**Command details:**  
Command details are listed on the pages  
which follow.

Command	Required cycles	Function
RTPS	14	Coordinate transformation & perspective transformation
RTPT	22	Coordinate transformation & perspective transformation
NCDS	19	Light source calculation
NCDT	44	Light source calculation
NCCS	17	Light source calculation
NCCT	39	Light source calculation
CDP	13	Light source calculation
CC	11	Light source calculation
NCS	14	Light source calculation
NCT	30	Light source calculation
MVMVA	8	Matrix calculation
DCPL	8	Depth cueing
INTPL	8	Interpolation
DPCS	8	Depth cueing
DPCT	17	Depth cueing
SQR	5	Vector squaring
AVSZ3	5	Z-averaging
AVSZ4	6	Z-averaging
NCLIP		Normal clipping
OP	6	Outer product
QPF	5	General purpose interpolation
GPL	5	General purpose interpolation

Function: Coordinate transformation and perspective transformation

## Calculations:

```

(1.31.12) SSX = TRX + R11*VX0 + R12*VY0 + R13*VZ0; <1>
(1.31.12) SSY = TRY + R21*VX0 + R22*VY0 + R23*VZ0; <2>
(1.31.12) SSZ = TRZ + R31*VX0 + R32*VY0 + R33*VZ0; <3>
(1.15. 0) IR1 = ImA1S(SSX);
(1.15. 0) IR2 = ImA2S(SSY);
(1.15. 0) IR3 = ImA3S(SSZ);
(0.16. 0) SZx0(0) <- SZ0(1) <- SZ1(2) <- SZ2(3) <- ImC(SSZ);
(1.27.16) SX = OFX + IR1*H/SZ; <4>
(1.27.16) SY = OFY + IR2*H/SZ; <4>
(1.19.24) P = DQB + DQA*H/SZ; <4>
(1. 3.12) IR0 = ImE(P)
(1.15. 0) SX0 <- SX1 <- SX2 <- ImD1(SX);
(1.15. 0) SY0 <- SY1 <- SY2 <- ImD2(SY);
(1. 7.24) MAC0 = P;
(1.31. 0) MAC1 = SSX;
(1.31. 0) MAC2 = SSY;
(1.31. 0) MAC3 = SSZ;

```

Referenced registers:		Modified registers:	
Data	Control	Data	Control
0 <b>VX0</b> , <b>VY0</b>	<b>R11</b> , <b>R12</b>	0 <b>VX0</b> , <b>VY0</b>	<b>R11</b> , <b>R12</b>
1 <b>VZ0</b>	<b>R13</b> , <b>R21</b>	1 <b>VZ0</b>	<b>R13</b> , <b>R21</b>
2 <b>VX1</b> , <b>VY1</b>	<b>R22</b> , <b>R23</b>	2 <b>VX1</b> , <b>VY1</b>	<b>R22</b> , <b>R23</b>
3 <b>VZ1</b>	<b>R31</b> , <b>R32</b>	3 <b>VZ1</b>	<b>R31</b> , <b>R32</b>
4 <b>VX2</b> , <b>VY2</b>	<b>R33</b>	4 <b>VX2</b> , <b>VY2</b>	<b>R33</b>
5 <b>VZ2</b>	<b>TRX</b>	5 <b>VZ2</b>	<b>TRX</b>
6 <b>RGB</b> <b>CODE</b>	<b>TRY</b>	6 <b>RGB</b> <b>CODE</b>	<b>TRY</b>
7 <b>OTZ</b>	<b>TRZ</b>	7 <b>OTZ</b>	<b>TRZ</b>
8 <b>IR0</b>	<b>L11</b> , <b>L12</b>	8 <b>IR0</b>	<b>L11</b> , <b>L12</b>
9 <b>IR1</b>	<b>L13</b> , <b>L21</b>	9 <b>IR1</b>	<b>L13</b> , <b>L21</b>
10 <b>IR2</b>	<b>L22</b> , <b>L23</b>	10 <b>IR2</b>	<b>L22</b> , <b>L23</b>
11 <b>IR3</b>	<b>L31</b> , <b>L32</b>	11 <b>IR3</b>	<b>L31</b> , <b>L32</b>
12 <b>SX0</b> , <b>SY0</b>	<b>L33</b>	12 <b>SX0</b> , <b>SY0</b>	<b>L33</b>
13 <b>SX1</b> , <b>SY1</b>	<b>RBK</b>	13 <b>SX1</b> , <b>SY1</b>	<b>RBK</b>
14 <b>SX2</b> , <b>SY2</b>	<b>QBK</b>	14 <b>SX2</b> , <b>SY2</b>	<b>QBK</b>
15 <b>SX2P</b> , <b>SY2P</b>	<b>BBK</b>	15 <b>SX2P</b> , <b>SY2P</b>	<b>BBK</b>
16 <b>SZx0</b>	<b>LR1</b> , <b>LR2</b>	16 <b>SZx0</b>	<b>LR1</b> , <b>LR2</b>
17 <b>SZ0</b> (1)	<b>LR3</b> , <b>LQ1</b>	17 <b>SZ0</b> (1)	<b>LR3</b> , <b>LQ1</b>
18 <b>SZ1</b> (2)	<b>LQ2</b> , <b>LQ3</b>	18 <b>SZ1</b> (2)	<b>LQ2</b> , <b>LQ3</b>
19 <b>SZ2</b> (3)	<b>LB1</b> , <b>LB2</b>	19 <b>SZ2</b> (3)	<b>LB1</b> , <b>LB2</b>
20 <b>R0</b> , <b>Q0</b> , <b>B0</b>	<b>LB3</b>	20 <b>R0</b> , <b>Q0</b> , <b>B0</b>	<b>LB3</b>
21 <b>R1</b> , <b>Q1</b> , <b>B1</b>	<b>RFC</b>	21 <b>R1</b> , <b>Q1</b> , <b>B1</b>	<b>RFC</b>
22 <b>R2</b> , <b>Q2</b> , <b>B2</b>	<b>QFC</b>	22 <b>R2</b> , <b>Q2</b> , <b>B2</b>	<b>QFC</b>
23 <b>BFC</b>	<b>BFC</b>	23 <b>BFC</b>	<b>BFC</b>
24 <b>MAC0</b>	<b>OFX</b>	24 <b>MAC0</b>	<b>OFX</b>
25 <b>MAC1</b>	<b>OPY</b>	25 <b>MAC1</b>	<b>OPY</b>
26 <b>MAC2</b>	<b>H</b>	26 <b>MAC2</b>	<b>H</b>
27 <b>MAC3</b>	<b>DQA</b>	27 <b>MAC3</b>	<b>DQA</b>
28 <b>IRQB</b>	<b>DQB</b>	28 <b>IRQB</b>	<b>DQB</b>
29 <b>ORQB</b>	<b>ZSF3</b>	29 <b>ORQB</b>	<b>ZSF3</b>
30 <b>DATA32</b>	<b>ZSF4</b>	30 <b>DATA32</b>	<b>ZSF4</b>
31 <b>LZC</b>	<b>FLAG</b>	31 <b>LZC</b>	<b>FLAG</b>

Referenced registers:		Modified registers:	
Data	Control	Data	Control
0 <b>VX0</b> , <b>VY0</b>	<b>R11</b> , <b>R12</b>	0 <b>VX0</b> , <b>VY0</b>	<b>R11</b> , <b>R12</b>
1 <b>VZ0</b>	<b>R13</b> , <b>R21</b>	1 <b>VZ0</b>	<b>R13</b> , <b>R21</b>
2 <b>VX1</b> , <b>VY1</b>	<b>R22</b> , <b>R23</b>	2 <b>VX1</b> , <b>VY1</b>	<b>R22</b> , <b>R23</b>
3 <b>VZ1</b>	<b>R31</b> , <b>R32</b>	3 <b>VZ1</b>	<b>R31</b> , <b>R32</b>
4 <b>VX2</b> , <b>VY2</b>	<b>R33</b>	4 <b>VX2</b> , <b>VY2</b>	<b>R33</b>
5 <b>VZ2</b>	<b>TRX</b>	5 <b>VZ2</b>	<b>TRX</b>
6 <b>RGB</b> <b>CODE</b>	<b>TRY</b>	6 <b>RGB</b> <b>CODE</b>	<b>TRY</b>
7 <b>OTZ</b>	<b>TRZ</b>	7 <b>OTZ</b>	<b>TRZ</b>
8 <b>IR0</b>	<b>L11</b> , <b>L12</b>	8 <b>IR0</b>	<b>L11</b> , <b>L12</b>
9 <b>IR1</b>	<b>L13</b> , <b>L21</b>	9 <b>IR1</b>	<b>L13</b> , <b>L21</b>
10 <b>IR2</b>	<b>L22</b> , <b>L23</b>	10 <b>IR2</b>	<b>L22</b> , <b>L23</b>
11 <b>IR3</b>	<b>L31</b> , <b>L32</b>	11 <b>IR3</b>	<b>L31</b> , <b>L32</b>
12 <b>SX0</b> , <b>SY0</b>	<b>L33</b>	12 <b>SX0</b> , <b>SY0</b>	<b>L33</b>
13 <b>SX1</b> , <b>SY1</b>	<b>RBK</b>	13 <b>SX1</b> , <b>SY1</b>	<b>RBK</b>
14 <b>SX2</b> , <b>SY2</b>	<b>QBK</b>	14 <b>SX2</b> , <b>SY2</b>	<b>QBK</b>
15 <b>SX2P</b> , <b>SY2P</b>	<b>BBK</b>	15 <b>SX2P</b> , <b>SY2P</b>	<b>BBK</b>
16 <b>SZx0</b>	<b>LR1</b> , <b>LR2</b>	16 <b>SZx0</b>	<b>LR1</b> , <b>LR2</b>
17 <b>SZ0</b> (1)	<b>LR3</b> , <b>LQ1</b>	17 <b>SZ0</b> (1)	<b>LR3</b> , <b>LQ1</b>
18 <b>SZ1</b> (2)	<b>LQ2</b> , <b>LQ3</b>	18 <b>SZ1</b> (2)	<b>LQ2</b> , <b>LQ3</b>
19 <b>SZ2</b> (3)	<b>LB1</b> , <b>LB2</b>	19 <b>SZ2</b> (3)	<b>LB1</b> , <b>LB2</b>
20 <b>R0</b> , <b>Q0</b> , <b>B0</b>	<b>LB3</b>	20 <b>R0</b> , <b>Q0</b> , <b>B0</b>	<b>LB3</b>
21 <b>R1</b> , <b>Q1</b> , <b>B1</b>	<b>RFC</b>	21 <b>R1</b> , <b>Q1</b> , <b>B1</b>	<b>RFC</b>
22 <b>R2</b> , <b>Q2</b> , <b>B2</b>	<b>QFC</b>	22 <b>R2</b> , <b>Q2</b> , <b>B2</b>	<b>QFC</b>
23 <b>BFC</b>	<b>BFC</b>	23 <b>BFC</b>	<b>BFC</b>
24 <b>MAC0</b>	<b>OFX</b>	24 <b>MAC0</b>	<b>OFX</b>
25 <b>MAC1</b>	<b>OPY</b>	25 <b>MAC1</b>	<b>OPY</b>
26 <b>MAC2</b>	<b>H</b>	26 <b>MAC2</b>	<b>H</b>
27 <b>MAC3</b>	<b>DQA</b>	27 <b>MAC3</b>	<b>DQA</b>
28 <b>IRQB</b>	<b>DQB</b>	28 <b>IRQB</b>	<b>DQB</b>
29 <b>ORQB</b>	<b>ZSF3</b>	29 <b>ORQB</b>	<b>ZSF3</b>
30 <b>DATA32</b>	<b>ZSF4</b>	30 <b>DATA32</b>	<b>ZSF4</b>
31 <b>LZC</b>	<b>FLAG</b>	31 <b>LZC</b>	<b>FLAG</b>

## RIPT

**Required cycles:22**  
**Function:** Coordinate transformation and perspective transformation\_

**Calculations:**

n=0,1,2 {

(1.31.12)  $\text{SSXn} = \text{TRX} + R11^*VXn + R12^*VYn + R13^*VZn; <1>$   
 (1.31.12)  $\text{SSYn} = \text{TRY} + R21^*VXn + R22^*VYn + R23^*VZn; <2>$   
 (1.31.12)  $\text{SSZn} = \text{TRZ} + R31^*VXn + R32^*VYn + R33^*VZn; <3>$

(0.18. 0)  $\text{SZx}(0) = \text{SZ2}(3);$

(0.18. 0)  $\text{SZ0}(1) = \text{ImC}(\text{SSZ0});$

(0.18. 0)  $\text{SZ0}(2) = \text{ImC}(\text{SSZ1});$

(0.18. 0)  $\text{SZ0}(3) = \text{ImC}(\text{SSZ2});$

(1.27.16)  $\text{SXn} = \text{OFX} + \text{IR1}^*(H/SZ n); <4>$

(1.27.16)  $\text{SYn} = \text{OFY} + \text{IR2}^*(H/SZ n); <4>$

(1.19.24)  $\text{P} = \text{DQB} + \text{DQA}^*(H/SZ2); <4>$

(1. 3.12)  $\text{IR0} = \text{ImE}(\text{P});$

(1.15. 0)  $\text{SXn} = \text{ImD1}(\text{SXn});$

(1.15. 0)  $\text{SYn} = \text{ImD2}(\text{SYn});$

}

(1.15. 0)  $\text{IR1} = \text{ImA1S}(\text{SSX2});$

(1.15. 0)  $\text{IR2} = \text{ImA2S}(\text{SSY2});$

(1.15. 0)  $\text{IR3} = \text{ImA3S}(\text{SSZ2});$

(1. 7.24)  $\text{MAC0} = \text{E};$

(1.31. 0)  $\text{MAC1} = \text{SSX2};$

(1.31. 0)  $\text{MAC2} = \text{SSY2};$

(1.31. 0)  $\text{MAC3} = \text{SSZ2};$

## Modified registers:

	Data	Control
0	VX0.VY0	R11.R12
1	VZ0	R13.R21
2	VX1.VY1	R22.R23
3	VZ1	R31.R32
4	VX2.VY2	R33.
5	VZ2	TRX
6	RGB CODE	TRY
7	OTZ	TRZ
8	IR0	L11.L12
9	IR1	L13.L21
10	IR2	L22.L23
11	IR3	L31.L32
12	SX0.SY0	L33.
13	SX1.SY1	RBK
14	SX2.SY2	QBK
15	SX2P.SY2P	BBK
16	SZx(0)	LR1.LR2
17	SZ0(1)	LR3.LQ1
18	SZ1(2)	LQ2.LQ3
19	SZ2(3)	LB1.LB2
20	RO Q0 B0	LB3.
21	R1 Q1 B1	REC
22	R2 Q2 B2	QFC
23	BFC	BFC
24	MAC0 OFX	OFX
25	MAC1 OFY	OPY
26	MAC2 H	H.
27	MAC3 DQA	DQA.
28	IRGB DQB	DQB
29	ORG B ZSF3.	ORG B ZSF3.
30	DATA32 ZSF4.	DATA32 ZSF4.
31	LZC FLAG	FLAG

	Data	Control
0	VX0.VY0	R11.R12
1	VZ0	R13.R21
2	VX1.VY1	R22.R23
3	VZ1	R31.R32
4	VX2.VY2	R33.
5	VZ2	TRX
6	RGB CODE	TRY
7	OTZ	TRZ
8	IR0	L11.L12
9	IR1	L13.L21
10	IR2	L22.L23
11	IR3	L31.L32
12	SX0.SY0	L33.
13	SX1.SY1	RBK
14	SX2.SY2	QBK
15	SX2P.SY2P	BBK
16	SZx(0)	LR1.LR2
17	SZ0(1)	LR3.LQ1
18	SZ1(2)	LQ2.LQ3
19	SZ2(3)	LB1.LB2
20	RO Q0 B0	LB3.
21	R1 Q1 B1	REC
22	R2 Q2 B2	QFC
23	BFC	BFC
24	MAC0 OFX	OFX
25	MAC1 OFY	OPY
26	MAC2 H	H.
27	MAC3 DQA	DQA.
28	IRGB DQB	DQB
29	ORG B ZSF3.	ORG B ZSF3.
30	DATA32 ZSF4.	DATA32 ZSF4.
31	LZC FLAG	FLAG

## NCDS

### Required cycles:19

Function: Light source calculation

#### Calculations:

```

(1.19.24) LL1 = L11"VX0 + L12"VY0 + L13"VZ0; <1>
(1.19.24) LL2 = L21"VX0 + L22"VY0 + L23"VZ0; <2>
(1.19.24) LL3 = L31"VX0 + L32"VY0 + L33"VZ0; <3>
(1. 3.12) L1 = ||mA1U(LL1);
(1. 3.12) L2 = ||mA2U(LL2);
(1. 3.12) L3 = ||mA3U(LL3);
(1.19.24) BBLT = RBK + LR1*L1 + LR2*L2 + LR3*L3; <1>
(1.19.24) QBLT = QBK + LG1*L1 + LG2*L2 + LG3*L3; <2>
(1.19.24) BBLT = BBK + LB1*L1 + LB2*L2 + LB3*L3; <3>
(1. 3.12) RLT = ||mA1U(RRLT);
(1. 3.12) GLT = ||mA2U(QGLT);
(1. 3.12) BLT = ||mA3U(BBLT);
(1.27.16) RR0 = R*RLT + IR0*||mA1S(RFC - R*RLT); <1>
QQ0 = G*GLT + IR0*||mA2S(QFC - G*GLT); <2>
BB0 = B*BBLT + IR0*||mA3S(BFC - B*BBLT); <3>
(1.27.16) IR1 = ||mA1U(RR0);
(1.27.16) IR2 = ||mA2U(QQ0);
(1.11. 4) IR3 = ||mA3U(BB0);
(1.11. 4) CD0 <- CD1 <- CD2 <- CODE
(1. 8. -) R0 <- R1 <- R2 <- ||mB1(RR0);
(0. 8. 0) G0 <- G1 <- G2 <- ||mB2(QQ0);
(0. 8. 0) B0 <- B1 <- B2 <- ||mB3(BB0);
(1.27. 4) MAC1 = RR0;
MAC2 = QQ0;
MAC3 = BB0;

```

Referenced registers:		Modified registers:	
Data	Control	Data	Control
0 VX0,VY0	R11,R12	0 VX0,VY0	R11,R12
1 VZ0	R13,R21	1 VZ0	R13,R21
2 VX1,VY1	R22,R23	2 VX1,VY1	R22,R23
3 VZ1	R31,R32	3 VZ1	R31,R32
4 VX2,VY2	R33,	4 VX2,VY2	R33,
5 VZ2	TRX	5 VZ2	TRX
6 RGB CODE	TRY	6 RGB CODE	TRY
7 OTZ	TRZ	7 OTZ	TRZ
8 IR0	L11,L12	8 IR0	L11,L12
9 IR1	L13,L21	9 IR1	L13,L21
10 IR2	L22,L23	10 IR2	L22,L23
11 IR3	L31,L32	11 IR3	L31,L32
12 SX0,SY0	L33,	12 SX0,SY0	L33,
13 SX1,SY1	RBK	13 SX1,SY1	RBK
14 SX2,SY2	QBK	14 SX2,SY2	QBK
15 SX2P,SY2P	BBK	15 SX2P,SY2P	BBK
16 SXz(0)	LR1,LR2	16 SXz(0)	LR1,LR2
17 SZ0(1)	LR3,LQ1	17 SZ0(1)	LR3,LQ1
18 SZ1(2)	LQ2,LQ3	18 SZ1(2)	LQ2,LQ3
19 SZ2(3)	LB1,LB2	19 SZ2(3)	LB1,LB2
20 R0 Q0 B0	LB3,	20 R0 Q0 B0	LB3,
21 R1 Q1 B1	RFC	21 R1 Q1 B1	RFC
22 R2 Q2 B2	QFC	22 R2 Q2 B2	QFC
23 BFO	BFC	23 BFO	BFC
24 MAC0	OFX	24 MAC0	OFX
25 MAC1	OPY	25 MAC1	OPY
26 MAC2	H,	26 MAC2	H,
27 MAC3	DQA,	27 MAC3	DQA,
28 IRQB	DQB	28 IRQB	DQB
29 ORQB	ZSF3,	29 ORQB	ZSF3,
30 DATA32	ZSF4,	30 DATA32	ZSF4,
31 L2C	FLAG	31 L2C	FLAG

Referenced registers:		Modified registers:	
Data	Control	Data	Control
0		0	
1		1	
2		2	
3		3	
4		4	
5		5	
6		6	
7		7	
8		8	
9		9	
10		10	
11		11	
12		12	
13		13	
14		14	
15		15	
16		16	
17		17	
18		18	
19		19	
20		20	
21		21	
22		22	
23		23	
24		24	
25		25	
26		26	
27		27	
28		28	
29		29	
30		30	
31		31	

## NCDT Required cycles:44

Function:	Light source calculation	Required cycles:44
<b>Calculations:</b>		
n=0,1,2 {		
(1.19.24) $LL1n = L11^*VXn + L12^*Vyn + L13^*VZn; <1>$		
(1.19.24) $LL2n = L21^*VXn + L22^*Vyn + L23^*VZn; <2>$		
(1.19.24) $LL3n = L31^*VXn + L32^*Vyn + L33^*VZn; <3>$		
(1. 3.12) $L1n = \text{ImA1U(LL1n);}$		
(1. 3.12) $L2n = \text{ImA2U(LL2n);}$		
(1. 3.12) $L3n = \text{ImA3U(LL3n);}$		
(1.19.24) $BB1Tn = FBK + LR1^*L1n + LR2^*L2n + LR3^*L3n; <1>$		
(1.19.24) $BB2Tn = BBK + LG1^*L1n + LG2^*L2n + LG3^*L3n; <2>$		
(1.19.24) $BB3Tn = BBK + LB1^*L1n + LB2^*L2n + LB3^*L3n; <3>$		
(1. 3.12) $RLTn = \text{ImA1U(RRLTn);}$		
(1. 3.12) $GLTn = \text{ImA2U(QQLTn);}$		
(1. 3.12) $BLTn = \text{ImA3U(BBLTn);}$		
(1.27.16) $RRn = R^*RLTn + IR0^*\text{ImA1S(RFC - R*RLTn); <1>}$		
(1.27.16) $QQn = G^*GLTn + IR0^*\text{ImA2S(GFC - G*GLTn); <2>}$		
(1.27.16) $BBn = B^*BLTn + IR0^*\text{ImA3S(BFC - B*BLTn); <3>}$		
(-. 8. -) $CDn = \text{CODE}$		
(-. 8. 0) $Rn = \text{ImB1(RBn); Gn = \text{ImB2(QGn);}$		
(-. 8. 0) $Bn = \text{ImB3(BBn);}$		
}		
(1.11. 4) $IR1 = \text{ImA1U(RR2);}$		
(1.11. 4) $IR2 = \text{ImA2U(QQ2);}$		
(1.11. 4) $IR3 = \text{ImA3U(BB2);}$		
(1.27. 4) $MAC1 = BB2;$		
(1.27. 4) $MAC2 = QQ2;$		
(1.27. 4) $MAC3 = BB2;$		
(1.11. 4) $MAC0 = \text{CODE}$		
(1.11. 4) $OFX = \text{OFX}$		
23 $MAC0 = \text{OFX}$		
24 $MAC1 = \text{OPY}$		
25 $MAC1 = \text{OPY}$		
26 $MAC2 = H;$		
27 $MAC3 = DQA;$		
28 $IRQB = DQB$		
29 $ORG = ZSF3;$		
30 $DATA32 = ZSF4;$		
31 $LZC = FLAG$		

## Modified registers:

	Data	Control	Data	Control
0	VX0.VY0	R11.R12	0	VX0.VY0
1	VZ0	R13.R21	1	VZ0
2	VX1.VY1	R22.R23	2	VX1.VY1
3	VZ1	R31.R32	3	VZ1
4	VX2.VY2	R33.	4	VX2.VY2
5	VZ2	TRX	5	VZ2
6	RGB CODE	TRY	6	RGB CODE
7	OTZ	TRY	7	OTZ
8	IR0	TRZ	8	IR0
9	IR1	TRZ	9	IR1
10	IR2	TRZ	10	IR2
11	IR3	TRZ	11	IR3
12	SX0.SY0	TRY	12	SX0.SY0
13	SX1.SY1	TRY	13	SX1.SY1
14	SX2.SY2	TRY	14	SX2.SY2
15	SX2P.SY2P	BBK	15	SX2P.SY2P
16	SZx0	BBK	16	SZx0
17	SZ0(1)	BBK	17	SZ0(1)
18	SZ1(2)	BBK	18	SZ1(2)
19	SZ2(3)	BBK	19	SZ2(3)
20	RG0.B0	BBK	20	RG0.B0
21	R1.Q1.B1	BBK	21	R1.Q1.B1
22	R2.Q2.B2	BBK	22	R2.Q2.B2
23	BFC	BBK	23	BFC
24	MAC0	OFX	24	MAC0
25	MAC1	OPY	25	MAC1
26	MAC2	H,	26	MAC2
27	MAC3	DQA,	27	MAC3
28	IRQB	DQB	28	IRQB
29	ORG	ZSF3,	29	ORG
30	DATA32	ZSF4,	30	DATA32
31	LZC	FLAG	31	LZC

## NCCS

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### Required cycles: 17

Function: Light source calculation

Referenced registers:	
Data	Control
0 VX0.VY0	R11.R12
1 VZ0	R13.R21
2 VX1.VY1	R22.R23
3 VZ1	R31.R32
4 VX2.VY2	R33.
5 VZ2	TRX
6 RGB_CODE	TRY
7 OTZ	TRZ
8 IR0	L11.L12
9 IR1	L13.L21
10 IR2	L22.L23
11 IR3	L31.L32
12 SX0.SY0	L33.
13 SX1.SY1	RBK
14 SX2.SY2	QBK
15 SX2P.SY2P	BBK
16 SZx0	LB1.LB2
17 SZ0(1)	LB3.LG1
18 SZ1(2)	LQ2.LQ3
19 SZ2(3)	LB1.LB2
20 R0.Q0.B0	LB3.
21 R1.Q1.B1	RFC
22 R2.Q2.B2	QFC
23 BFC	BFC
24 MAC0	OFX
25 MAC1	OPY
26 MAC2	H.
27 MAC3	DQA.
28 IRQB	DQB
29 ORQB	ZSF3.
30 DATA32	ZSF4.
31 LZC	FLAG

Modified registers:	
Data	Control
0 VX0.VY0	R11.R12
1 VZ0	R13.R21
2 VX1.VY1	R22.R23
3 VZ1	R31.R32
4 VX2.VY2	R33.
5 VZ2	TRX
6 RGB_CODE	TRY
7 OTZ	TRZ
8 IR0	L11.L12
9 IR1	L13.L21
10 IR2	L22.L23
11 IR3	L31.L32
12 SX0.SY0	L33.
13 SX1.SY1	RBK
14 SX2.SY2	QBK
15 SX2P.SY2P	BBK
16 SZx0	LB1.LB2
17 SZ0(1)	LB3.LG1
18 SZ1(2)	LQ2.LQ3
19 SZ2(3)	LB1.LB2
20 R0.Q0.B0	LB3.
21 R1.Q1.B1	RFC
22 R2.Q2.B2	QFC
23 BFC	BFC
24 MAC0	OFX
25 MAC1	OPY
26 MAC2	H.
27 MAC3	DQA.
28 IRQB	DQB
29 ORQB	ZSF3.
30 DATA32	ZSF4.
31 LZC	FLAG

**Calculations:**

(1.19.24)  $LL1 = L11*VX0 + L12*VY0 + L13*VZ0; <1>$   
 (1.19.24)  $LL2 = L21*VX0 + L22*VY0 + L23*VZ0; <2>$   
 (1.19.24)  $LL3 = L31*VX0 + L32*VY0 + L33*VZ0; <3>$   
 (1. 3.12)  $L1 = \text{ImA}(LL1);$   
 (1. 3.12)  $L2 = \text{ImA}(LL2);$   
 (1. 3.12)  $L3 = \text{ImA}(LL3);$   
 (1.19.24)  $BLT = RBK + LG1*L1 + LG2*L2 + LG3*L3; <1>$   
 (1.19.24)  $BBT = BBK + LB1*L1 + LB2*L2 + LB3*L3; <2>$   
 (1. 3.12)  $RLT = \text{ImA1U}(BBT);$   
 (1. 3.12)  $GLT = \text{ImA2U}(GALD);$   
 (1. 3.12)  $BLT = \text{ImA3U}(BBT);$   
 (1.27.16)  $BB0 = R*RLT; <1>$   
 (1.27.16)  $QQ0 = G*GLT; <2>$   
 (1.27.16)  $BB0 = B*BLT; <3>$   
 (1.11. 4)  $IR1 = \text{ImA1U}(BB0);$   
 (1.11. 4)  $IR2 = \text{ImA2U}(QQ0);$   
 (1.11. 4)  $IR3 = \text{ImA3U}(BB0);$   
 (-. 8. -)  $CD0 <- CD1 <- CD2 <- CODE$   
 (0. 8. 0)  $R0 <- R1 <- R2 <- \text{ImB1}(BB0);$   
 (0. 8. 0)  $G0 <- G1 <- G2 <- \text{ImB2}(QQ0);$   
 (1.27. 4)  $MAC1 = BB0;$   
 (1.27. 4)  $MAC2 = QQ0;$   
 (1.27. 4)  $MAC3 = BB0;$

## NCCT Required cycles: 39

Function: Light source calculation

### Calculations:

n=0,1,2 {  
 (1.19.24) L1n = L11\*VXn + L12\*VYn + L13\*VZn; <1>  
 (1.19.24) L2n = L21\*VXn + L22\*VYn + L23\*VZn; <2>  
 (1.19.24) L3n = L31\*VXn + L32\*VYn + L33\*VZn; <3>  
 (1. 3.12) L1n = ImA1U(LL1n);  
 (1. 3.12) L2n = ImA2U(LL2n);  
 (1. 3.12) L3n = ImA3U(LL3n);  
 (1.19.24) RRLTn = RBK + LR1\*L1n + LR2\*L2n + LR3\*L3n; <1>  
 (1.19.24) QQLTn = QBK + LG1\*L1n + LG2\*L2n + LG3\*L3n; <2>  
 (1.19.24) BBLTn = BBK + LB1\*L1n + LB2\*L2n + LB3\*L3n; <3>  
 (1. 3.12) RLTn = ImA1U(RBLTn);  
 (1. 3.12) GLTn = ImA2U(GLLTn);  
 (1. 3.12) BLTn = ImA3U(BBLTn);  
 (1.27.16) BBn = R\*RLTn; <1>  
 (1.27.16) QGn = G\*GLTn; <2>  
 (1.27.16) BGn = B\*BLTn; <3>  
 (1. 8. -) CDn = CODE  
 (0. 8. 0) Rn = ImB1(BFn);  
 (0. 8. 0) Gn = ImB2(QGn);  
 (0. 8. 0) Bn = ImB3(BFn);  
 }  
 (1.11. 4) IR1 = ImA1U(BB2); IR2 = ImA2U(QG2);  
 (1.11. 4) IR3 = ImA3U(BB2);  
 (1.27. 4) MAC1 = BB2; MAC2 = QG2;  
 (1.27. 4) MAC3 = BB2;

### Referenced registers:

	Data	Control
0	VX0.VY0	R11.R12
1	VZ0	R13.R21
2	VX1.VY1	R22.R23
3	VZ1	R31.R32
4	VX2.VY2	R33.
5	VZ2	TRX
6	RGB CODE	TRY
7	OTZ	TRZ
8	IR0	L11.L12
9	IR1	L13.L21
10	IR2	L22.L23
11	IR3	L31.L32
12	SX0.SY0	L33.
13	SX1.SY1	RBK
14	SX2.SY2	GBK
15	SX2P.SY2P	BBK
16	SZx0	LR1.LR2
17	SZ0(1)	LR3.LQ1
18	SZ1(2)	LQ2.LQ3
19	SZ2(3)	LB1.LB2
20	RO.Q0.B0	LB3.
21	R1.Q1.B1	RFC
22	R2.Q2.B2	GFC
23	BFC	BFC
24	MAC0.QFX	OFX
25	MAC1.QPY	OPY
26	MAC2.H.	H.
27	MAC3.DQA.	DQA.
28	IRGB.DQB	DQB
29	ORGB.ZSF3.	ZSF3.
30	DATA32.ZSF4.	ZSF4.
31	LZC.FLAG	FLAG

	Data	Control
0	VX0.VY0	R11.R12
1	VZ0	R13.R21
2	VX1.VY1	R22.R23
3	VZ1	R31.R32
4	VX2.VY2	R33.
5	VZ2	TRX
6	RGB CODE	TRY
7	OTZ	TRZ
8	IR0	L11.L12
9	IR1	L13.L21
10	IR2	L22.L23
11	IR3	L31.L32
12	SX0.SY0	L33.
13	SX1.SY1	RBK
14	SX2.SY2	GBK
15	SX2P.SY2P	BBK
16	SZx0	LR1.LR2
17	SZ0(1)	LR3.LQ1
18	SZ1(2)	LQ2.LQ3
19	SZ2(3)	LB1.LB2
20	RO.Q0.B0	LB3.
21	R1.Q1.B1	RFC
22	R2.Q2.B2	GFC
23	BFC	BFC
24	MAC0.QFX	OFX
25	MAC1.QPY	OPY
26	MAC2.H.	H.
27	MAC3.DQA.	DQA.
28	IRGB.DQB	DQB
29	ORGB.ZSF3.	ZSF3.
30	DATA32.ZSF4.	ZSF4.
31	LZC.FLAG	FLAG

Function: Light source calculation

## Calculations:

(1.19.24)  $BBLT = RBK + LR1*IR1 + LR2*IR2 + LR3*IR3; <1>$   
 (1.19.24)  $QQLT = QBK + LG1*IR1 + LG2*IR2 + LG3*IR3; <2>$   
 (1.19.24)  $BBLT = BBK + LB1*IR1 + LB2*IR2 + LB3*IR3; <3>$   
 (1. 3.12)  $RLT = \text{limA1U}(BBLT);$   
 (1. 3.12)  $GLT = \text{limA2U}(QQLT);$   
 (1. 3.12)  $BLT = \text{limA3U}(BBLT);$   
 (1.27.16)  $BB0 = R*RLT + IR0*\text{limA1S}(RFC - R*RLT); <1>$   
 (1.27.16)  $QQ0 = G*GLT + IR0*\text{limA2S}(RFC - G*GLT); <2>$   
 (1.27.16)  $BB0 = B*BLT + IR0*\text{limA3S}(BFC - B*BLT); <3>$   
 (1.11. 4)  $IR1 = \text{limA1U}(BB0);$   
 (1.11. 4)  $IR2 = \text{limA2U}(QQ0);$   
 (1.11. 4)  $IR3 = \text{limA3U}(BB0);$   
 (-. 8. -)  $CD0 <- CD1 <- CD2 <- CODE$   
 (0. 8. 0)  $R0 <- R1 <- R2 <- \text{limB1}(BB0);$   
 (0. 8. 0)  $G0 <- G1 <- G2 <- \text{limB2}(QQ0);$   
 (0. 8. 0)  $B0 <- B1 <- B2 <- \text{limB3}(BB0);$   
 (1.27. 4)  $MAC1 = BB0;$   
 (1.27. 4)  $MAC2 = QQ0;$   
 (1.27. 4)  $MAC3 = BB0;$

Referenced registers:		Modified registers:	
Data	Control	Data	Control
0 VX0.VY0	R11.R12	0 VX0.VY0	R11.R12
1 VZ0	R13.R21	1 VZ0	R13.R21
2 VX1.VY1	R22.R23	2 VX1.VY1	R22.R23
3 VZ1	R31.R32	3 VZ1	R31.R32
4 VX2.VY2	R33.	4 VX2.VY2	R33.
5 VZ2	TRX	5 VZ2	TRX
6 RGB.CODE	TRY	6 RGB.CODE	TRY
7 OTZ	TRZ	7 OTZ	TRZ
8 IR0	L11.L12	8 IR0	L11.L12
9 IR1	L13.L21	9 IR1	L13.L21
10 IR2	L22.L23	10 IR2	L22.L23
11 IR3	L31.L32	11 IR3	L31.L32
12 SX0.SY0	L33.	12 SX0.SY0	L33.
13 SX1.SY1	RBK	13 SX1.SY1	RBK
14 SX2.SY2	QBK	14 SX2.SY2	QBK
15 SX2P.SY2P	BBK	15 SX2P.SY2P	BBK
16 SZx0	LR1.LR2	16 SZx0	LR1.LR2
17 SZ0(1)	LR3.LQ1	17 SZ0(1)	LR3.LQ1
18 SZ1(2)	LQ2.LQ3	18 SZ1(2)	LQ2.LQ3
19 SZ2(3)	LB1.LB2	19 SZ2(3)	LB1.LB2
20 R0.G0.B0	LB3.	20 R0.G0.B0	LB3.
21 R1.Q1.B1	RFC	21 R1.Q1.B1	RFC
22 R2.Q2.B2	GFC	22 R2.Q2.B2	GFC
23 BFC		23 BFC	
24 MAC0	OFX	24 MAC0	OFX
25 MAC1	OPY	25 MAC1	OPY
26 MAC2	H.	26 MAC2	H.
27 MAC3	DQA.	27 MAC3	DQA.
28 IRQB	DQB	28 IRQB	DQB
29 ORQB	ZSF3.	29 ORQB	ZSF3.
30 DATA32	ZSF4.	30 DATA32	ZSF4.
31 LZC	FLAG	31 LZC	FLAG

Referenced registers:		Modified registers:	
Data	Control	Data	Control
0 VX0.VY0	R11.R12	0 VX0.VY0	R11.R12
1 VZ0	R13.R21	1 VZ0	R13.R21
2 VX1.VY1	R22.R23	2 VX1.VY1	R22.R23
3 VZ1	R31.R32	3 VZ1	R31.R32
4 VX2.VY2	R33.	4 VX2.VY2	R33.
5 VZ2	TRX	5 VZ2	TRX
6 RGB.CODE	TRY	6 RGB.CODE	TRY
7 OTZ	TRZ	7 OTZ	TRZ
8 IR0	L11.L12	8 IR0	L11.L12
9 IR1	L13.L21	9 IR1	L13.L21
10 IR2	L22.L23	10 IR2	L22.L23
11 IR3	L31.L32	11 IR3	L31.L32
12 SX0.SY0	L33.	12 SX0.SY0	L33.
13 SX1.SY1	RBK	13 SX1.SY1	RBK
14 SX2.SY2	QBK	14 SX2.SY2	QBK
15 SX2P.SY2P	BBK	15 SX2P.SY2P	BBK
16 SZx0	LR1.LR2	16 SZx0	LR1.LR2
17 SZ0(1)	LR3.LQ1	17 SZ0(1)	LR3.LQ1
18 SZ1(2)	LQ2.LQ3	18 SZ1(2)	LQ2.LQ3
19 SZ2(3)	LB1.LB2	19 SZ2(3)	LB1.LB2
20 R0.G0.B0	LB3.	20 R0.G0.B0	LB3.
21 R1.Q1.B1	RFC	21 R1.Q1.B1	RFC
22 R2.Q2.B2	GFC	22 R2.Q2.B2	GFC
23 BFC		23 BFC	
24 MAC0	OFX	24 MAC0	OFX
25 MAC1	OPY	25 MAC1	OPY
26 MAC2	H.	26 MAC2	H.
27 MAC3	DQA.	27 MAC3	DQA.
28 IRQB	DQB	28 IRQB	DQB
29 ORQB	ZSF3.	29 ORQB	ZSF3.
30 DATA32	ZSF4.	30 DATA32	ZSF4.
31 LZC	FLAG	31 LZC	FLAG

## CC Required cycles: 11

Function: Light source calculation

**Calculations:**

(1.19.24) **BBL1 = RBK + LR1\*IR1 + LR2\*IR2 + LR3\*IR3; <1>**  
**QQL1 = QBK + LG1\*IR1 + LG2\*IR2 + LG3\*IR3; <2>**  
**BBL1 = BBBK + LB1\*IR1 + LB2\*IR2 + LB3\*IR3; <3>**

(1.19.24) **RLT = ImA1U(BBL1);**  
**GLT = ImA2U(QQL1);**

(1. 3.12) **BLT = ImA3U(BBL1);**  
**RRQ = R\*RLT; <1>**  
**QQQ = G\*GLT; <2>**  
**BBQ = B\*BLT; <3>**

(1.27.16) **IR1 = ImA1U(RRQ);**  
**IR2 = ImA2U(QQQ);**  
**IR3 = ImA3U(BBQ);**

(1.11. 4) **CDO <- CD1 <- CDD2 <- CODE**  
**R0 <- R1 <- R2 <- ImB1(BBQ);**  
**G0 <- G1 <- G2 <- ImB2(QQQ);**  
**B0 <- B1 <- B2 <- ImB3(BBQ);**

(1.27. 4) **MAC1 = RRQ;**  
**MAC2 = QQQ;**  
**MAC3 = BBQ;**

(1.27. 4)

## Required cycles: 11

### Referenced registers:

	Data	Control	
0	VX0.VY0	R11.R12	
1	Y20	R13.R21	
2	VX1.VY1	R22.R23	
3	VZ1	R31.R32	
4	VX2.VY2	R33.	
5	VZ2	TRX	
6	RGB_CODE	TRY	
7	OTZ	TRZ	
8	IR0	L11.L12	
9	IR1	L13.L21	
10	IR2	L22.L23	
11	IR3	L31.L32	
12	SX0.SY0	L33.	
13	SX1.SY1	RBK	
14	SX2.SY2	QBK	
15	SX2P.SY2P	BBK	
16	S2x0	LRI.LR2	
17	SZ0(1)	LRS.LQ1	
18	SZ1(2)	G2.G3	
19	SZ2(3)	LBI.LB2	
20	R0 Q0 B0	LB3.	
21	R1 Q1 B1	RFC	
22	R2 Q2 B2	QFC	
23	BFC		
24	MAC0	OFX	
25	MAC1	OPY	
26	MAC2	H.	
27	MAC3	DQA.	
28	IRQB	DQB	
29	ORGQ	ZSF3.	
30	DATA32	ZSF4.	
31	L2C	FLAG	

	Data	Control	
0	VX0.VY0	R11.R12	
1	Y20	R13.R21	
2	VX1.VY1	R22.R23	
3	VZ1	R31.R32	
4	VX2.VY2	R33.	
5	VZ2	TRX	
6	RGB_CODE	TRY	
7	OTZ	TRZ	
8	IR0	L11.L12	
9	IR1	L13.L21	
10	IR2	L22.L23	
11	IR3	L31.L32	
12	SX0.SY0	L33.	
13	SX1.SY1	RBK	
14	SX2.SY2	QBK	
15	SX2P.SY2P	BBK	
16	S2x0	LRI.LR2	
17	SZ0(1)	LRS.LQ1	
18	SZ1(2)	G2.G3	
19	SZ2(3)	LBI.LB2	
20	R0 Q0 B0	LB3.	
21	R1 Q1 B1	RFC	
22	R2 Q2 B2	QFC	
23	BFC		
24	MAC0	OFX	
25	MAC1	OPY	
26	MAC2	H.	
27	MAC3	DQA.	
28	IRQB	DQB	
29	ORGQ	ZSF3.	
30	DATA32	ZSF4.	
31	L2C	FLAG	

Function: Light source calculation

Referenced registers:	Data	Control
0	VX0.VY0	R11.R12
1	VZ0	R13.R21
2	VX1.VY1	R22.R23
3	VZ1	R31.R32
4	VX2.VY2	R33.
5	VZ2	TRX
6	RGB	COD
7	OTZ	TRY
8	IR0	L11.L12
9	IR1	L13.L21
10	IR2	L22.L23
11	IR3	L31.L32
12	SX0.SY0	L33.
13	SX1.SY1	RBK
14	SX2.SY2	QBK
15	SX2P.SY2P	BBK
16	SZx(0)	LR1.LR2
17	SZ0(1)	LR3.LG1
18	SZ1(2)	LQ2.LQ3
19	SZ2(3)	LB1.LB2
20	R0.Q0.B0	LB3.
21	R1.Q1.B1	RFC
22	R2.Q2.B2	QFC
23	BFC	BFC
24	MAC0	OFX
25	MAC1	OPY
26	MAC2	H.
27	MAC3	DQA.
28	IRQB	DQB
29	ORQB	ZSF3.
30	DATA32	ZSF4.
31	LZC	FLAG

Modified registers:	Data	Control
0	VX0.VY0	R11.R12
1	VZ0	R13.R21
2	VX1.VY1	R22.R23
3	VZ1	R31.R32
4	VX2.VY2	R33.
5	VZ2	TRX
6	RGB	CODE
7	OTZ	TRY
8	IR0	L11.L12
9	IR1	L13.L21
10	IR2	L22.L23
11	IR3	L31.L32
12	SX0.SY0	L33.
13	SX1.SY1	RBK
14	SX2.SY2	QBK
15	SX2P.SY2P	BBK
16	SZx(0)	LR1.LB2
17	SZ0(1)	LR3.LG1
18	SZ1(2)	LQ2.LQ3
19	SZ2(3)	LB1.LB2
20	R0.Q0.B0	LB3.
21	R1.Q1.B1	RFC
22	R2.Q2.B2	QFC
23	BFC	BFC
24	MAC0	OFX
25	MAC1	OPY
26	MAC2	H.
27	MAC3	DQA.
28	IRQB	DQB
29	ORQB	ZSF3.
30	DATA32	ZSF4.
31	LZC	FLAG

**Calculations:**

(1.19.24)  $LL1 = L11*VX0 + L12*VY0 + L13*VZ0; <1>$   
 (1.19.24)  $LL2 = L21*VX0 + L22*VY0 + L23*VZ0; <2>$   
 (1.19.24)  $LL3 = L31*VX0 + L32*VY0 + L33*VZ0; <3>$   
 (1. 3.12)  $L1 = |ImA1U(LL1)|;$   
 (1. 3.12)  $L2 = |ImA2U(LL2)|;$   
 (1. 3.12)  $L3 = |ImA3U(LL3)|;$   
 (1.19.24)  $RB0 = RBK + LR1*L1 + LR2*L2 + LR3*L3; <1>$   
 (1.19.24)  $BB0 = BBK + LB1*L1 + LB2*L2 + LB3*L3; <2>$   
 (1. 3.12)  $IR1 = |ImA1U(BB0)|;$   
 (1. 3.12)  $IR2 = |ImA2U(BB0)|;$   
 (1. 3.12)  $IR3 = |ImA3U(BB0)|;$   
 (-, 8, -)  $CD0 <- CD1 <- CD2 <- CODE$   
 (0, 0, 8)  $R0 <- R1 <- R2 <- |ImB1(BB0)|;$   
 (0, 0, 8)  $G0 <- G1 <- G2 <- |ImB2(BB0)|;$   
 (0, 0, 8)  $B0 <- B1 <- B2 <- |ImB3(BB0)|;$   
 (1.19.12)  $MAC1 = BB0;$   
 (1.19.12)  $MAC2 = BB0;$   
 (1.19.12)  $MAC3 = BB0;$

Function: Light source calculation

Requierted by: 30

### Calculations:

```

n=0,1,2 {
  (1.19.24) LL1n = L11"VXn + L12"VYn + L13"VZn; <1>
  (1.19.24) LL2n = L21"VXn + L22"VYn + L23"VZn; <2>
  (1.19.24) LL3n = L31"VXn + L32"VYn + L33"VZn; <3>
  (1. 3.12) L1n = ImA1U(LL1n);
  (1. 3.12) L2n = ImA2U(LL2n);
  (1. 3.12) L3n = ImA3U(LL3n);
  (1.19.24) BBn = RBK + LR1*L1n + LR2*L2n + LR3*L3n; <1>
  (1.19.24) QGn = GBK + LG1*L1n + LG2*L2n + LG3*L3n; <2>
  (1.19.24) BBn = BBK + LB1*L1n + LB2*L2n + LB3*L3n; <3>
  (-. 6. -) CDn = CODE
  (0. 0. 8) Rn = ImB1(BBn);
  (0. 0. 8) Gn = ImB2(QGn);
  (0. 0. 8) Bn = ImB3(BBn);
}

  (1. 3.12) IR1 = ImA1U(BB2);
  (1. 3.12) IR2 = ImA2U(QG2);
  (1. 3.12) IR3 = ImA3U(BB2);
  (1.19.12) MAC1 = BB2;
  (1.19.12) MAC2 = QG2;
  (1.19.12) MAC3 = BB2;
}

```

Referenced registers:		Control
	Data	
0	VX0VY0	R11.R12
1	VZ0	R13.R21
2	VX1.VY1	R22.R23
3	VZ1	R31.R32
4	VX2.VY2	R33.
5	VZ2	TRX
6	RGB	QOD
7	OTZ	TRY
8	IR0	TRZ
9	IR1	
10	IR2	
11	IR3	
12	SX0.SY0	
13	SX1.SY1	
14	SX2.SY2	
15	SX2P.SY2P	
16	SZx(0)	
17	SZ0(1)	
18	SZ1(2)	
19	SZ2(3)	
20	RO GO BO	
21	R1 Q1 B1	RFC
22	R2 Q2 B2	QFC
23		BFC
24	MAC0	DFX
25	MAC1	OPV
26	MAC2	H
27	MAC3	DQA
28	IRGB	DQB
29	ORGB	ZSF3.
30	DATA32	ZSF4.
31	LZC	FLAG

Modified registers:		Control
	Data	
0	VX0.VY0	R11.R12
1	VZ0	R13.R21
2	VX1.VY1	R22.R23
3	VZ1	R31.R32
4	VX2.VY2	R33.
5	VZ2	TRX
6	RGB CODE	TRY
7	OTZ	TRZ
8	IRO	L11.L12
9	IR1	L13.L21
10	IR2	L22.L23
11	IR3	L31.L32
12	SX0.SY0	L33.
13	SX1.SY1	RBK
14	SX2.SY2	GBK
15	SX2P.SY2P	BBK
16	SZX0)	LR1.LR2
17	SZ0(1)	LR3.LQ1
18	SZ1(2)	LQ2.LQ3
19	SZ2(3)	LB1.LB2
20	PG0.B0	LB3.
21	R1.G1.B1	RFC
22	R2.G2.B2	GFC
23		BFC
24	MAC0	OFX
25	MAC1	OPY
26	MAC2	H.
27	MAC3	DQA.
28	IRQB	DQB
29	ORGB	ZSF3.
30	DATA32	ZSF4.
31	LC	FAQ

## MMVA.slmxx.vcvlm

Required cycles: 8

Function: Matrix and vector multiplication

Items specified using arguments:

Argu- ment	Specified content	Value=0	Value = 1	Value=2	Value = 3
<b>sf</b>	Scaling format	Scale large	Scale small	Not valid	Not valid
<b>mx</b>	Multiplication array (MX) (1.3.12)	R	L	LR	Not valid
<b>v</b>	Multiplication vector (V) (1.m.n)	Vp0 p-X/Y/Z	Vp1 p-X/Y/Z	Vp2 p-X/Y/Z	IRp p-0/1/2
<b>cv</b>	Addition vector (CV) (1.16+m. n)	TRP p-X/Y/Z	PBK p-R/B/G	PFC p-R/B/G	0
<b>lm</b>	Limiter A1/2/3 lower limit	-2^15	0	Not valid	Not valid

\* Data formats

The multiplication matrix data format is fixed.  
The other data formats are determined by the multiplication vector data format.

Calculations: (m and n are determined by the multiplication vector data format.)

(1.16+m.n+12) **MT1** = CV1 + MX11\*V1 + MX12\*V2 + MX13\*V3; <1>  
(1.m-12,n+12) **MT2** = CV2 + MX21\*V1 + MX22\*V2 + MX23\*V3; <2>  
(1.m-12,n+12) **MT3** = CV3 + MX31\*V1 + MX32\*V2 + MX33\*V3; <3>  
(1.16+m,n) **MAC1** = MT1  
(1.16+m,n) **MAC2** = MT2  
(1.16+m,n) **MAC3** = MT3

Referenced registers:	Modified registers:
Data	Control
VX0,VY0	R11,R12
VZ0	R13,R21
VX1,VY1	R22,R23
VZ2	R31,R32
IR0	VZ1
OTZ	VX2,VY2
TRY	VZ2
RGB CODE	TRY
TRZ	OTZ
TR2	TRZ
IR0	L11,L12
IR1	L13,L21
IR2	L22,L23
IR3	L31,L32
SX0,SY0	L33.
SX1,SY1	RBK
SX2,SY2	QBK
SX2P,SY2P	BBK
SZx0	LR1,LR2
SZ0(1)	LR3,LQ1
SZ1(2)	LQ2,LQ3
SZ2(3)	LB1,LB2
R0 Q0 B0	LB3.
R1 Q1 B1	RFC
R2 Q2 B2	QFC
BFC	BFC
OFX	OFX
MAC0	MAC0
MAC1	MAC1
MAC2	MAC2
MAC3	MAC3
IRQB	DQB
ORQB	ZSF3.
DATA32	ZSF4.
LZC	FLAG

Referenced registers:	Modified registers:
MAC0	OFX
MAC1	OFX
MAC2	OFX
MAC3	OFX
IRQB	DQB
ORQB	DQB
DATA32	ZSF4.
LZC	FLAG

sf == 0

sf == 1

(1.m-12,n+12) (1.m,n) IR1 = lmA1C(MT1);

(1.m-12,n+12) (1.m,n) IR2 = lmA2C(MT2)

(1.m-12,n+12) (1.m,n) IR3 = lmA3C(MT3)

## DCPL Required Cycles: 8

Function: Depth cueing

**Calculations:**

(1.27.16)  $RR0 = R^*IR1 + IR0^*ImA1S(RFC - R^*IR1); <1>$   
 (1.27.16)  $QQ0 = G^*IR2 + IR0^*ImA2S(QFC - G^*IR2); <2>$   
 (1.27.16)  $BB0 = B^*IR3 + IR0^*ImA3S(BFC - B^*IR3); <3>$   
 (1.11. 4)  $IR1 = ImA1S(IR0);$   
 (1.11. 4)  $IR2 = ImA2S(QQ0);$   
 (1.11. 4)  $IR3 = ImA3S(BB0);$   
 (‐. 8.‐)  $CD0 \leftarrow CD1 \leftarrow CD2 \leftarrow CODE$   
 (0. 8. 0)  $R0 \leftarrow R1 \leftarrow R2 \leftarrow ImB1(IR0);$   
 (0. 8. 0)  $G0 \leftarrow G1 \leftarrow G2 \leftarrow ImB2(QQ0);$   
 (0. 8. 0)  $B0 \leftarrow B1 \leftarrow B2 \leftarrow ImB3(BB0);$   
 (1.27. 4)  $MAC1 = RR0;$   
 (1.27. 4)  $MAC2 = QQ0;$   
 (1.27. 4)  $MAC3 = BB0;$

## Referenced registers:

Control	Data	Control	Data	Control	Data
IR0	VX0.VY0	IR1	V11.R12	IR2	V11.R12
IR1	V20	IR2	V13.R21	IR3	V13.R21
IR2	VX1.VY1	IR3	V22.R23		
IR3	V21				
	VX2.VY2				
	V22				
	RGB CODE				
	TRY				
	OTZ				
	TRZ				
	IR0				
	L11.L12				
	IR1				
	L13.L21				
	IR2				
	L22.L23				
	IR3				
	L31.L32				
	SX0.SY0				
	L33.				
	SX1.SY1				
	RBK				
	GBK				
	SX2P.SY2P				
	BBK				
	S2X(0)				
	LR1.LR2				
	SZ0(1)				
	LR3.LQ1				
	SZ1(2)				
	LQ2.LQ3				
	SZ2(3)				
	LB1.LB2				
	R0.Q0.B0				
	LB3.				
	R1.Q1.B1				
	RFC				
	R2.Q2.B2				
	GFC				
	BFC				
	MAC0				
	QFX				
	MAC1				
	OPY				
	MAC2				
	H.				
	DQA.				
	MAC3				
	DQA.				
	MAC4				
	DQA.				
	DQB				
	IRGB				
	ORG				
	ZSF3.				
	DATA32				
	ZSF4.				
	FLAG				
	L2C				
	FLAG				

## Modified registers:

Control	Data	Control	Data	Control	Data
0	VX0.VY0	1	VZ0	2	VX1.VY1
1	V20	2	V13.R21	3	V21
2	VX1.VY1	3	V22.R23	4	VX2.VY2
3	VZ1	5	VZ2	6	VX2.VY2
4	VX2.VY2	7	RGB CODE	8	V10
5	VZ2	9	TRY	10	V12
6	RGB CODE	11	OTZ	12	V11.L12
7	TRY	13	TRZ	14	V13.L21
8	OTZ	15	IR1	16	V12
9	TRZ	17	IR2	18	V11.L12
10	IR1	19	IR3	20	V13.L21
11	IR2	21	IR4	22	V12
12	IR3	23	IR5	24	V11.L12
13	IR4	25	IR6	26	V12
14	IR5	27	IR7	28	V11.L12
15	IR6	29	IR8	30	V12
16	IR7	31	IR9	32	V11.L12
17	IR8	33	IR10	34	V12
18	IR9	35	IR11	36	V11.L12
19	IR10	37	IR12	38	V12
20	IR11	39	IR13	40	V11.L12
21	IR12	41	IR14	42	V12
22	IR13	43	IR15	44	V11.L12
23	IR14	45	IR16	46	V12
24	IR15	47	IR17	48	V11.L12
25	IR16	49	IR18	50	V12
26	IR17	51	IR19	52	V11.L12
27	IR18	53	IR20	54	V12
28	IR19	55	IR21	56	V11.L12
29	IR20	57	IR22	58	V12
30	IR21	59	IR23	60	V11.L12
31	IR22	61	IR24	62	V12

## INTPL

Required cycles: 8

Function: Interpolation

**Calculations:** (m and n request the data format of IRp(p=1,2,3) as

```

(1.m,n)
(1.16+m,n+12)  IPL1 = 1.0*IR1 + IR0*limA1S(RFC-1.0*IR1); <1>
(1.16+m,n+12)  IPL2 = 1.0*IR2 + IR0*limA2S(QFC-1.0*IR2); <2>
(1.16+m,n+12)  IPL3 = 1.0*IR3 + IR0*limA3S(BFC-1.0*IR3); <3>
(1. m, n)      IR1 = limA1S(IPL1);
(1. m, n)      IR2 = limA2S(IPL2);
(1. m, n)      IR3 = limA3S(IPL3);
(-, 8, -)      CD0 <- CD1 <- CD2 = CODE
(0.12-n, n-4)  R0 <- R1 <- R2 <- limB1(IPL1);
(0.12-n, n-4)  G0 <- G1 <- G2 <- limB2(IPL2);
(0.12-n, n-4)  B0 <- B1 <- B2 <- limB3(IPL3);
(1.16+m, n)    MAC1 = IPL1;
(1.16+m, n)    MAC2 = IPL2;
(1.16+m, n)    MAC3 = IPL3;

```

Referenced registers:		Modified registers:	
Data	Control	Data	Control
0 VX0.VY0	R11.R12	0 VX0.VY0	R11.R12
1 VZ0	R13.R21	1 VZ0	R13.R21
2 VX1.VY1	R22.R23	2 VX1.VY1	R22.R23
3 VZ1	R31.R32	3 VZ1	R31.R32
4 VX2.VY2	R33.	4 VX2.VY2	R33.
5 VZ2	TRX	5 VZ2	TRX
6 RGB COD	TRY	6 RGB CODE	TRY
7 OTZ	TRZ	7 OTZ	TRZ
8 IR0	L11.L12	8 IR0	L11.L12
9 IR1	L13.L21	9 IR1	L13.L21
10 IR2	L22.L23	10 IR2	L22.L23
11 IR3	L31.L32	11 IR3	L31.L32
12 SX0.SY0	L33.	12 SX0.SY0	L33.
13 SX1.SY1	RBK	13 SX1.SY1	RBK
14 SX2.SY2	QBK	14 SX2.SY2	QBK
15 SX2P.SY2P	BBK	15 SX2P.SY2P	BBK
16 SX0(0)	LR1.LR2	16 SX0(0)	LR1.LR2
17 SZ0(1)	LR3.LQ1	17 SZ0(1)	LR3.LQ1
18 SZ1(2)	LQ2.LQ3	18 SZ1(2)	LQ2.LQ3
19 SZ2(3)	LB1.LB2	19 SZ2(3)	LB1.LB2
20 R0 Q0 B0	LB3.	20 R0 Q0 B0	LB3.
21 R1 Q1 B1	RFC	21 R1 Q1 B1	RFC
22 R2 Q2 B2	QFC	22 R2 Q2 B2	QFC
23 BFC		23 BFC	
24 MAC0	OFX	24 MAC0	OFX
25 MAC1	OPY	25 MAC1	OPY
26 MAC2	H.	26 MAC2	H.
27 MAC3	DQA.	27 MAC3	DQA.
28 IRQB	DQB	28 IRQB	DQB
29 ORQB	ZSF3.	29 ORQB	ZSF3.
30 DATA32	ZSF4.	30 DATA32	ZSF4.
31 L2C	FLAG	31 L2C	FLAG

Referenced registers:		Modified registers:	
Data	Control	Data	Control
0 VX0.VY0	R11.R12	0 VX0.VY0	R11.R12
1 VZ0	R13.R21	1 VZ0	R13.R21
2 VX1.VY1	R22.R23	2 VX1.VY1	R22.R23
3 VZ1	R31.R32	3 VZ1	R31.R32
4 VX2.VY2	R33.	4 VX2.VY2	R33.
5 VZ2	TRX	5 VZ2	TRX
6 RGB COD	TRY	6 RGB CODE	TRY
7 OTZ	TRZ	7 OTZ	TRZ
8 IR0	L11.L12	8 IR0	L11.L12
9 IR1	L13.L21	9 IR1	L13.L21
10 IR2	L22.L23	10 IR2	L22.L23
11 IR3	L31.L32	11 IR3	L31.L32
12 SX0.SY0	L33.	12 SX0.SY0	L33.
13 SX1.SY1	RBK	13 SX1.SY1	RBK
14 SX2.SY2	QBK	14 SX2.SY2	QBK
15 SX2P.SY2P	BBK	15 SX2P.SY2P	BBK
16 SX0(0)	LR1.LR2	16 SX0(0)	LR1.LR2
17 SZ0(1)	LR3.LQ1	17 SZ0(1)	LR3.LQ1
18 SZ1(2)	LQ2.LQ3	18 SZ1(2)	LQ2.LQ3
19 SZ2(3)	LB1.LB2	19 SZ2(3)	LB1.LB2
20 R0 Q0 B0	LB3.	20 R0 Q0 B0	LB3.
21 R1 Q1 B1	RFC	21 R1 Q1 B1	RFC
22 R2 Q2 B2	QFC	22 R2 Q2 B2	QFC
23 BFC		23 BFC	
24 MAC0	OFX	24 MAC0	OFX
25 MAC1	OPY	25 MAC1	OPY
26 MAC2	H.	26 MAC2	H.
27 MAC3	DQA.	27 MAC3	DQA.
28 IRQB	DQB	28 IRQB	DQB
29 ORQB	ZSF3.	29 ORQB	ZSF3.
30 DATA32	ZSF4.	30 DATA32	ZSF4.
31 L2C	FLAG	31 L2C	FLAG

**DPCS**      **Required cycles: 8**

Function: Depth cueing

**Calculations:**

(1.27.16)  $RR0 = R^*1.0 + IR0 * \text{ImA1S}(\text{RFC}-R^*1.0); <1>$   
 (1.27.16)  $QQ0 = G^*1.0 + IR0 * \text{ImA2S}(\text{QFC}-G^*1.0); <2>$   
 (1.27.16)  $BB0 = B^*1.0 + IR0 * \text{ImA3S}(\text{BFC}-B^*1.0); <3>$

(1.11. 4)  $IR1 = \text{ImA1S}(BB0);$   
 (1.11. 4)  $IR2 = \text{ImA2S}(QQ0);$   
 (1.11. 4)  $IR3 = \text{ImA3S}(BB0);$   
 (‐. 8. ‐)  $CD0 \leftarrow CD1 \leftarrow CD2 \leftarrow \text{CODE}$   
 (0. 8. 0)  $RO \leftarrow R1 \leftarrow R2 \leftarrow \text{ImB1}(BB0);$   
 (0. 8. 0)  $GO \leftarrow G1 \leftarrow G2 \leftarrow \text{ImB2}(QQ0);$   
 (0. 8. 0)  $BO \leftarrow B1 \leftarrow B2 \leftarrow \text{ImB3}(BB0);$   
 (1.27. 4)  $MAC1 = RR0;$   
 (1.27. 4)  $MAC2 = QQ0;$   
 (1.27. 4)  $MAC3 = BB0;$

**Referenced registers:**

	Data	Control	
0	VX0.VY0	R11.R12	
1	VZ0	R13.R21	
2	VX1.VY1	R22.R23	
3	VZ1	R31.R32	
4	VX2.VY2	R33.	
5	VZ2	TRX	
6	RGB_CODE	TRY	
7	OTZ	TRZ	
8	IR0	L11.L12	
9	IR1	L13.L21	
10	IR2	L22.L23	
11	IR3	L31.L32	
12	SX0.SY0	L33.	
13	SX1.SY1	RBK	
14	SX2.SY2	QBK	
15	SX2P.SY2P	BBK	
16	SZx(0)	LR1.LR2	
17	SZ0(1)	LR3.LQ1	
18	SZ1(2)	LQ2.LQ3	
19	SZ2(3)	LB1.LB2	
20	RO.Q0.B0	LB3.	
21	R1.Q1.B1	RFC	
22	R2.Q2.B2	QFC	
23	BFC		
24	MAC0	QFX	
25	MAC1	OPY	
26	MAC2	H.	
27	MAC3	DQA.	
28	IRGB	DQB	
29	ORGB	ZSF3.	
30	DATA32	ZSF4.	
31	LZC	FLAG	

**Modified registers:**

	Data	Control	
0	VX0.VY0	R11.R12	
1	VZ0	R13.R21	
2	VX1.VY1	R22.R23	
3	VZ1	R31.R32	
4	VX2.VY2	R33.	
5	VZ2	TRX	
6	RGB_CODE	TRY	
7	OTZ	TRZ	
8	IR0	L11.L12	
9	IR1	L13.L21	
10	IR2	L22.L23	
11	IR3	L31.L32	
12	SX0.SY0	L33.	
13	SX1.SY1	RBK	
14	SX2.SY2	QBK	
15	SX2P.SY2P	BBK	
16	SZx(0)	LR1.LR2	
17	SZ0(1)	LR3.LQ1	
18	SZ1(2)	LQ2.LQ3	
19	SZ2(3)	LB1.LB2	
20	RO.Q0.B0	LB3.	
21	R1.Q1.B1	RFC	
22	R2.Q2.B2	QFC	
23	BFC		
24	MAC0	QFX	
25	MAC1	OPY	
26	MAC2	H.	
27	MAC3	DQA.	
28	IRGB	DQB	
29	ORGB	ZSF3.	
30	DATA32	ZSF4.	
31	LZC	FLAG	

**DPCT**      **Required cycles: 17**

**Function:** Depth cueing

**Calculations:**

$n=0,1,2 \{$

(1.27,16)  $BBn = Rn^*1.0 + IR0^*ImA1SRFC-R^*1.0; <1>$

(1.27,16)  $QQn = Gn^*1.0 + IR0^*ImA2S(GFC-G^*1.0); <2>$

(1.27,16)  $BBn = Bn^*1.0 + IR0^*ImA3S(BFC-B^*1.0); <3>$

(1.11, 4)  $IR1 = ImA1S(BB2);$

(1.11, 4)  $IR2 = ImA2S(QQ2);$

(1.11, 4)  $IR3 = ImA3S(BB2);$

(-, 8, -)  $CDn = CODE$

(0, 8, 0)  $Rn = ImB1(BBn);$

(0, 8, 0)  $Gn = ImB2(QQn);$

(0, 8, 0)  $Bn = ImB3(BBn);$

}

(1.27, 4)  $MAC1 = BB2;$

(1.27, 4)  $MAC2 = QQ2;$

(1.27, 4)  $MAC3 = BB2;$

**VX0,VY0**

**R11,R12**

**VZ0**

**R13,R21**

**VX1,VY1**

**R22,R23**

**VZ1**

**R31,R32**

**VX2,VY2**

**R33.**

**VZ2**

**TRX**

**RQB CODE**

**TRY**

**OTZ**

**TRZ**

**IR0**

**L11,L12**

**IR1**

**L13,L21**

**IR2**

**L22,L23**

**IR3**

**L31,L32**

**SX0,SY0**

**L33.**

**SX1,SY1**

**RBK**

**SX2,SY2**

**QBK**

**SX2P,SY2P**

**BBK**

**SZx(0)**

**LB1,LB2**

**SZ0(1)**

**LR3,LQ1**

**SZ1(2)**

**LQ2,LQ3**

**SZ2(3)**

**LB1,LB2**

**R0,Q0,B0**

**LB3.**

**R1,Q1,B1**

**RFC**

**R2,Q2,B2**

**GFC**

**BFQ**

**23**

**MAC0**

**OFX**

**MAC1**

**OPY**

**MAC2**

**H.**

<b>Referenced registers:</b>		<b>Modified registers:</b>	
<b>Data</b>	<b>Control</b>	<b>Data</b>	<b>Control</b>
0 <b>VX0,VY0</b>	0 <b>R11,R12</b>	0 <b>VX0,VY0</b>	0 <b>R11,R12</b>
1 <b>VZ0</b>	1 <b>R13,R21</b>	1 <b>VZ0</b>	1 <b>R13,R21</b>
2 <b>VX1,VY1</b>	2 <b>R22,R23</b>	2 <b>VX1,VY1</b>	2 <b>R22,R23</b>
3 <b>VZ1</b>	3 <b>R31,R32</b>	3 <b>VZ1</b>	3 <b>R31,R32</b>
4 <b>VX2,VY2</b>	4 <b>R33.</b>	4 <b>VX2,VY2</b>	4 <b>R33.</b>
5 <b>VZ2</b>	5 <b>TRX</b>	5 <b>VZ2</b>	5 <b>TRX</b>
6 <b>RQB CODE</b>	6 <b>TRY</b>	6 <b>RQB CODE</b>	6 <b>TRY</b>
7 <b>OTZ</b>	7 <b>TRZ</b>	7 <b>OTZ</b>	7 <b>TRZ</b>
8 <b>IR0</b>	8 <b>L11,L12</b>	8 <b>IR0</b>	8 <b>L11,L12</b>
9 <b>IR1</b>	9 <b>L13,L21</b>	9 <b>IR1</b>	9 <b>L13,L21</b>
10 <b>IR2</b>	10 <b>L22,L23</b>	10 <b>IR2</b>	10 <b>L22,L23</b>
11 <b>IR3</b>	11 <b>L31,L32</b>	11 <b>IR3</b>	11 <b>L31,L32</b>
12 <b>SX0,SY0</b>	12 <b>L33.</b>	12 <b>SX0,SY0</b>	12 <b>L33.</b>
13 <b>SX1,SY1</b>	13 <b>RBK</b>	13 <b>SX1,SY1</b>	13 <b>RBK</b>
14 <b>SX2,SY2</b>	14 <b>QBK</b>	14 <b>SX2,SY2</b>	14 <b>QBK</b>
15 <b>SX2P,SY2P</b>	15 <b>BBK</b>	15 <b>SX2P,SY2P</b>	15 <b>BBK</b>
16 <b>SZx(0)</b>	16 <b>LB1,LB2</b>	16 <b>SZx(0)</b>	16 <b>LB1,LB2</b>
17 <b>SZ0(1)</b>	17 <b>LR3,LQ1</b>	17 <b>SZ0(1)</b>	17 <b>LR3,LQ1</b>
18 <b>SZ1(2)</b>	18 <b>LQ2,LQ3</b>	18 <b>SZ1(2)</b>	18 <b>LQ2,LQ3</b>
19 <b>SZ2(3)</b>	19 <b>LB1,LB2</b>	19 <b>SZ2(3)</b>	19 <b>LB1,LB2</b>
20 <b>R0,Q0,B0</b>	20 <b>LB3.</b>	20 <b>R0,Q0,B0</b>	20 <b>LB3.</b>
21 <b>R1,Q1,B1</b>	21 <b>RFC</b>	21 <b>R1,Q1,B1</b>	21 <b>RFC</b>
22 <b>R2,Q2,B2</b>	22 <b>GFC</b>	22 <b>R2,Q2,B2</b>	22 <b>GFC</b>
23 <b>BFQ</b>	23 <b>23</b>	23 <b>BFQ</b>	23 <b>23</b>
24 <b>MAC0</b>	24 <b>OFX</b>	24 <b>MAC0</b>	24 <b>OFX</b>
25 <b>MAC1</b>	25 <b>OPY</b>	25 <b>MAC1</b>	25 <b>OPY</b>
26 <b>MAC2</b>	26 <b>H.</b>	26 <b>MAC2</b>	26 <b>H.</b>
27 <b>MAC3</b>	27 <b>DQA.</b>	27 <b>MAC3</b>	27 <b>DQA.</b>
28 <b>IRQB</b>	28 <b>DQB</b>	28 <b>IRQB</b>	28 <b>DQB</b>
29 <b>ORGQ</b>	29 <b>ZSF3.</b>	29 <b>ORGQ</b>	29 <b>ZSF3.</b>
30 <b>DATA32</b>	30 <b>ZSF4.</b>	30 <b>DATA32</b>	30 <b>ZSF4.</b>
31 <b>LZC</b>	31 <b>FLAG</b>	31 <b>LZC</b>	31 <b>FLAG</b>

<b>Referenced registers:</b>		<b>Modified registers:</b>	
<b>Data</b>	<b>Control</b>	<b>Data</b>	<b>Control</b>
0 <b>VX0,VY0</b>	0 <b>R11,R12</b>	0 <b>VX0,VY0</b>	0 <b>R11,R12</b>
1 <b>VZ0</b>	1 <b>R13,R21</b>	1 <b>VZ0</b>	1 <b>R13,R21</b>
2 <b>VX1,VY1</b>	2 <b>R22,R23</b>	2 <b>VX1,VY1</b>	2 <b>R22,R23</b>
3 <b>VZ1</b>	3 <b>R31,R32</b>	3 <b>VZ1</b>	3 <b>R31,R32</b>
4 <b>VX2,VY2</b>	4 <b>R33.</b>	4 <b>VX2,VY2</b>	4 <b>R33.</b>
5 <b>VZ2</b>	5 <b>TRX</b>	5 <b>VZ2</b>	5 <b>TRX</b>
6 <b>RQB CODE</b>	6 <b>TRY</b>	6 <b>RQB CODE</b>	6 <b>TRY</b>
7 <b>OTZ</b>	7 <b>TRZ</b>	7 <b>OTZ</b>	7 <b>TRZ</b>
8 <b>IR0</b>	8 <b>L11,L12</b>	8 <b>IR0</b>	8 <b>L11,L12</b>
9 <b>IR1</b>	9 <b>L13,L21</b>	9 <b>IR1</b>	9 <b>L13,L21</b>
10 <b>IR2</b>	10 <b>L22,L23</b>	10 <b>IR2</b>	10 <b>L22,L23</b>
11 <b>IR3</b>	11 <b>L31,L32</b>	11 <b>IR3</b>	11 <b>L31,L32</b>
12 <b>SX0,SY0</b>	12 <b>L33.</b>	12 <b>SX0,SY0</b>	12 <b>L33.</b>
13 <b>SX1,SY1</b>	13 <b>RBK</b>	13 <b>SX1,SY1</b>	13 <b>RBK</b>
14 <b>SX2,SY2</b>	14 <b>QBK</b>	14 <b>SX2,SY2</b>	14 <b>QBK</b>
15 <b>SX2P,SY2P</b>	15 <b>BBK</b>	15 <b>SX2P,SY2P</b>	15 <b>BBK</b>
16 <b>SZx(0)</b>	16 <b>LB1,LB2</b>	16 <b>SZx(0)</b>	16 <b>LB1,LB2</b>
17 <b>SZ0(1)</b>	17 <b>LR3,LQ1</b>	17 <b>SZ0(1)</b>	17 <b>LR3,LQ1</b>
18 <b>SZ1(2)</b>	18 <b>LQ2,LQ3</b>	18 <b>SZ1(2)</b>	18 <b>LQ2,LQ3</b>
19 <b>SZ2(3)</b>	19 <b>LB1,LB2</b>	19 <b>SZ2(3)</b>	19 <b>LB1,LB2</b>
20 <b>R0,Q0,B0</b>	20 <b>LB3.</b>	20 <b>R0,Q0,B0</b>	20 <b>LB3.</b>
21 <b>R1,Q1,B1</b>	21 <b>RFC</b>	21 <b>R1,Q1,B1</b>	21 <b>RFC</b>
22 <b>R2,Q2,B2</b>	22 <b>GFC</b>	22 <b>R2,Q2,B2</b>	22 <b>GFC</b>
23 <b>BFQ</b>	23 <b>23</b>	23 <b>BFQ</b>	23 <b>23</b>
24 <b>MAC0</b>	24 <b>OFX</b>	24 <b>MAC0</b>	24 <b>OFX</b>
25 <b>MAC1</b>	25 <b>OPY</b>	25 <b>MAC1</b>	25 <b>OPY</b>
26 <b>MAC2</b>	26 <b>H.</b>	26 <b>MAC2</b>	26 <b>H.</b>
27 <b>MAC3</b>	27 <b>DQA.</b>	27 <b>MAC3</b>	27 <b>DQA.</b>
28 <b>IRQB</b>	28 <b>DQB</b>	28 <b>IRQB</b>	28 <b>DQB</b>
29 <b>ORGQ</b>	29 <b>ZSF3.</b>	29 <b>ORGQ</b>	29 <b>ZSF3.</b>
30 <b>DATA32</b>	30 <b>ZSF4.</b>	30 <b>DATA32</b>	30 <b>ZSF4.</b>
31 <b>LZC</b>	31 <b>FLAG</b>	31 <b>LZC</b>	31 <b>FLAG</b>

### SQR.SI

Required cycles: 5

Function: Vector squaring

Items specified using arguments:

Argument	Specified content	Value = 0	Value = 1
sf	Output format	-	Performs calculations on data shifted 12 bits to the left in the IRn register.

Calculations: (m and n request the data format of IRp(p=1,2,3) as

```
(1.m.n.)
sf == 0          sf == 1
(1.m+28..n)      (1..m+16..n+12)    L1 = IR1*IR1; <1>
(1..m+28..n)      (1..m+16..n+12)    L2 = IR2*IR2; <2>
(1..m+28..n)      (1..m+16..n+12)    L3 = IR3*IR3; <3>
(1..m..n)         (1..m+16..n+12)    IR1 = ImA1U(L1);
(1..m..n)         (1..m+16..n+12)    IR2 = ImA2U(L2);
(1..m..n)         (1..m+16..n+12)    IR3 = ImA3U(L3);
(1..m+16..0)       (1..m+8..n+12)    MAC1 = L1;
(1..m+16..0)       (1..m+16..n+12)    MAC2 = L2;
(1..m+16..0)       (1..m+16..n+12)    MAC3 = L3;
```

### Referenced registers:

Referenced registers:		Modified registers:	
	Data	Control	Control
0	VX0.VY0	R11..R12	R11..R12
1	VZ0	R13..R21	R13..R21
2	VX1.VY1	R22..R23	R22..R23
3	VZ1	R31..R32	R31..R32
4	VX2.VY2	R33..	R33..
5	VZ2	TRX	TRX
6	RGB_CODE	TRY	TRY
7	OTZ	TRZ	TRZ
8	IR0	L11..L12	L11..L12
9	IR1	L13..L21	L13..L21
10	IR2	L22..L23	L22..L23
11	IR3	L31..L32	L31..L32
12	SX0.SY0	L33..	L33..
13	SX1.SY1	RBK	RBK
14	SX2.SY2	QBK	QBK
15	SX2P.SY2P	BBK	BBK
16	SZx(0)	LR1..LR2	LR1..LR2
17	SZ0(1)	LR3..LQ1	LR3..LQ1
18	SZ1(2)	LQ2..LQ3	LQ2..LQ3
19	SZ2(3)	LB1..LB2	LB1..LB2
20	RO.Q0.B0	LB3..	LB3..
21	R1.Q1.B1	REC	REC
22	R2.Q2.B2	QFC	QFC
23	BFC	BFC	BFC
24	MAC0	OFX	OFX
25	MAC1	OPY	OPY
26	MAC2	H..	H..
27	MAC3	DQA..	DQA..
28	IRGB	DQB	DQB
29	ORG8	ZSF3..	ZSF3..
30	DATA32	ZSF4..	ZSF4..
31	LZC	FLAG	FLAG

### AVS23 Required cycles: 5

Function: Z-averaging

Calculations:

(1.31.21)  $\underline{QOTZ} = ZSF3^*SZ0(1)$   
 $+ ZSF3^*SZ1(2)$   
 $+ ZSF3^*SZ2(3); <4>$   
 $(0.16, 0) \quad OTZ = \underline{ImC}(\underline{QOTZ});$   
 $(1.31, 0) \quad MAC0 = \underline{QOTZ};$

Referenced registers:		Modified registers:	
	Data		Control
0	VX0.VY0	R11.R12	0
1	VZ0	R13.R21	1
2	VX1.VY1	R22.R23	2
3	VZ1	R31.R32	3
4	VX2.VY2	R33.	4
5	VZ2	TRX	5
6	RQB CODE	TRY	6
7	OTZ	TRZ	7
8	IR0	L11.L12	8
9	IR1	L13.L21	9
10	IR2	L22.L23	10
11	IR3	L31.L32	11
12	SX0.SY0	L33.	12
13	SX1.SY1	RBK	13
14	SX2.SY2	QBK	14
15	SX2P.SY2P	BBK	15
16	SZ0(0)	LR1.LR2	16
17	SZ0(1)	LR3.LQ1	17
18	SZ1(2)	LQ2.LQ3	18
19	SZ2(3)	LB1.LB2	19
20	R0.Q0.B0	LB3.	20
21	R1.Q1.B1	RFC	21
22	R2.Q2.B2	QFC	22
23	BFC	BFC	23
24	MAC0	OFX	24
25	MAC1	OPY	25
26	MAC2	H.	26
27	MAC3	DQA.	27
28	IRQB	DQB	28
29	ORQB	ZSF3.	29
30	DATA32	ZSF4.	30
31	LZC	FLAG	31

	Data		Control
0	VX0.VY0	R11.R12	0
1	VZ0	R13.R21	1
2	VX1.VY1	R22.R23	2
3	VZ1	R31.R32	3
4	VX2.VY2	R33.	4
5	VZ2	TRX	5
6	RQB CODE	TRY	6
7	OTZ	TRZ	7
8	IR0	L11.L12	8
9	IR1	L13.L21	9
10	IR2	L22.L23	10
11	IR3	L31.L32	11
12	SX0.SY0	L33.	12
13	SX1.SY1	RBK	13
14	SX2.SY2	QBK	14
15	SX2P.SY2P	BBK	15
16	SZ0(0)	LR1.LR2	16
17	SZ0(1)	LR3.LQ1	17
18	SZ1(2)	LQ2.LQ3	18
19	SZ2(3)	LB1.LB2	19
20	R0.Q0.B0	LB3.	20
21	R1.Q1.B1	RFC	21
22	R2.Q2.B2	QFC	22
23	BFC	BFC	23
24	MAC0	OFX	24
25	MAC1	OPY	25
26	MAC2	H.	26
27	MAC3	DQA.	27
28	IRQB	DQB	28
29	ORQB	ZSF3.	29
30	DATA32	ZSF4.	30
31	LZC	FLAG	31

Function: Z-averaging

**Calculations:**

$$(1.31.12) \quad \underline{QOTZ} = ZSF4^*SZx(0) + ZSF4^*SZ1(2) + ZSF4^*SZ2(3); <4>$$

$$(0.16. 0) \quad OTZ = \text{ImC}(\underline{QOTZ});$$

$$(1.31. 0) \quad MAC0 = \underline{QOTZ};$$
**Referenced registers:**

	Data	Control	Data	Control
0	VX0.VY0	R11.R12	0	VX0.VY0
1	VZ0	R13.R21	1	VZ0
2	VX1.VY1	R22.R23	2	VX1.VY1
3	VZ1	R31.R32	3	VZ1
4	VX2.VY2	R33.	4	VX2.VY2
5	VZ2	TRX	5	VZ2
6	RGB CODE	TRY	6	RGB CODE
7	OTZ	TRZ	7	OTZ
8	IR0	L11.L12	8	IR0
9	IR1	L13.L21	9	IR1
10	IR2	L22.L23	10	IR2
11	IR3	L31.L32	11	IR3
12	SX0.SY0	L33.	12	SX0.SY0
13	SX1.SY1	RBK	13	SX1.SY1
14	SX2.SY2	QBK	14	SX2.SY2
15	SX2P.SY2P	BBK	15	SX2P.SY2P
16	SZx(0)	LR1.LR2	16	S2x(0)
17	SZ0(1)	LR3.LQ1	17	S20(1)
18	SZ1(2)	LQ2.LQ3	18	S21(2)
19	SZ2(3)	LB1.LB2	19	S22(3)
20	R0 Q0 B0	LB3.	20	R0 Q0 B0
21	R1 Q1 B1	REC	21	R1 Q1 B1
22	R2 Q2 B2	QFC	22	R2 Q2 B2
23	BFC		23	BFC
24	MAC0	OFX	24	MAC0
25	MAC1	OPY	25	MAC1
26	MAC2	H.	26	MAC2
27	MAC3	DQA.	27	MAC3
28	IRGB	DQB	28	IRGB
29	ORGB	ZSF3.	29	ORGB
30	DATA32	ZSF4.	30	DATA32
31	LZC	FLAG	31	LZC

**Modified registers:**

	Data	Control
0	VX0.VY0	R11.R12
1	VZ0	R13.R21
2	VX1.VY1	R22.R23
3	VZ1	R31.R32
4	VX2.VY2	R33.
5	VZ2	TRX
6	RGB CODE	TRY
7	OTZ	TRZ
8	IR0	L11.L12
9	IR1	L13.L21
10	IR2	L22.L23
11	IR3	L31.L32
12	SX0.SY0	L33.
13	SX1.SY1	RBK
14	SX2.SY2	QBK
15	SX2P.SY2P	BBK
16	S2x(0)	LR1.LR2
17	S20(1)	LR3.LQ1
18	S21(2)	LQ2.LQ3
19	S22(3)	LB1.LB2
20	R0 Q0 B0	LB3.
21	R1 Q1 B1	REC
22	R2 Q2 B2	QFC
23	BFC	
24	MAC0	OFX
25	MAC1	OPY
26	MAC2	H.
27	MAC3	DQA.
28	IRGB	DQB
29	ORGB	ZSF3.
30	DATA32	ZSF4.
31	LZC	FLAG

## NCLIP

### Required cycles: 8

**Function:** Normal clipping

**Calculations:**

$$(1.31. 0) \quad \underline{\text{OPZ}} = \text{SX0} * \text{SY1} + \text{SX1} * \text{SY2} + \text{SX2} * \text{SY0} \\ - \text{SX0} * \text{SY2} - \text{SX1} * \text{SY0} - \text{SX2} * \text{SY1}; <4>$$

**MAC0 = OPZ;**

Referenced registers:		Modified registers:			
	Data		Data		
0	VX0.VY0	R11.R12	0	VX0.VY0	R11.R12
1	VZ0	R13.R21	1	VZ0	R13.R21
2	VX1.VY1	R22.R23	2	VX1.VY1	R22.R23
3	VZ1	R31.R32	3	VZ1	R31.R32
4	VX2.VY2	R33.	4	VX2.VY2	R33.
5	VZ2	TRX	5	VZ2	TRX
6	RQB CODE	TRY	6	RQB CODE	TRY
7	OTZ	TRZ	7	OTZ	TRZ
8	IR0	L11.L12	8	IR0	L11.L12
9	IR1	L13.L21	9	IR1	L13.L21
10	IR2	L22.L23	10	IR2	L22.L23
11	IR3	L31.L32	11	IR3	L31.L32
12	SX0.SY0	L33.	12	SX0.SY0	L33.
13	SX1.SY1	RBK	13	SX1.SY1	RBK
14	SX2.SY2	QBK	14	SX2.SY2	QBK
15	SX2P.SY2P	BBK	15	SX2P.SY2P	BBK
16	SZx0)	LR1.LR2	16	SZx0)	LR1.LR2
17	SZ0(1)	LR3.LQ1	17	SZ0(1)	LR3.LQ1
18	SZ1(2)	LQ2.LQ3	18	SZ1(2)	LQ2.LQ3
19	SZ2(3)	LB1.LB2	19	SZ2(3)	LB1.LB2
20	R0.G0.B0	LB3.	20	R0.G0.B0	LB3.
21	R1.Q1.B1	RFC	21	R1.Q1.B1	RFC
22	R2.Q2.B2	QFC	22	R2.Q2.B2	QFC
23	BFC		23	BFC	
24	MAC0	OFX	24	MAC0	OFX
25	MAC1	OPY	25	MAC1	OPY
26	MAC2	H.	26	MAC2	H.
27	MAC3	DQA.	27	MAC3	DQA.
28	IRQB	DQB	28	IRQB	DQB
29	ORQB	ZSF3.	29	ORQB	ZSF3.
30	DATA32	ZSF4.	30	DATA32	ZSF4.
31	LZC	FLAG	31	LZC	FLAG

Referenced registers:		Modified registers:			
	Data		Data		
0	VX0.VY0	R11.R12	0	VX0.VY0	R11.R12
1	VZ0	R13.R21	1	VZ0	R13.R21
2	VX1.VY1	R22.R23	2	VX1.VY1	R22.R23
3	VZ1	R31.R32	3	VZ1	R31.R32
4	VX2.VY2	R33.	4	VX2.VY2	R33.
5	VZ2	TRX	5	VZ2	TRX
6	RQB CODE	TRY	6	RQB CODE	TRY
7	OTZ	TRZ	7	OTZ	TRZ
8	IR0	L11.L12	8	IR0	L11.L12
9	IR1	L13.L21	9	IR1	L13.L21
10	IR2	L22.L23	10	IR2	L22.L23
11	IR3	L31.L32	11	IR3	L31.L32
12	SX0.SY0	L33.	12	SX0.SY0	L33.
13	SX1.SY1	RBK	13	SX1.SY1	RBK
14	SX2.SY2	QBK	14	SX2.SY2	QBK
15	SX2P.SY2P	BBK	15	SX2P.SY2P	BBK
16	SZx0)	LR1.LR2	16	SZx0)	LR1.LR2
17	SZ0(1)	LR3.LQ1	17	SZ0(1)	LR3.LQ1
18	SZ1(2)	LQ2.LQ3	18	SZ1(2)	LQ2.LQ3
19	SZ2(3)	LB1.LB2	19	SZ2(3)	LB1.LB2
20	R0.G0.B0	LB3.	20	R0.G0.B0	LB3.
21	R1.Q1.B1	RFC	21	R1.Q1.B1	RFC
22	R2.Q2.B2	QFC	22	R2.Q2.B2	QFC
23	BFC		23	BFC	
24	MAC0	OFX	24	MAC0	OFX
25	MAC1	OPY	25	MAC1	OPY
26	MAC2	H.	26	MAC2	H.
27	MAC3	DQA.	27	MAC3	DQA.
28	IRQB	DQB	28	IRQB	DQB
29	ORQB	ZSF3.	29	ORQB	ZSF3.
30	DATA32	ZSF4.	30	DATA32	ZSF4.
31	LZC	FLAG	31	LZC	FLAG

### QP.st

#### Required cycles: 6

Function: Outer product

Items specified using arguments:

Argument	Specified content	Value = 0	Value = 1
sf	Output format	-	Performs calculations on data shifted 12 bits to the left in the IRn register.

Calculations: : (m and n request the data format of IRp(p-1,2,3) as

(1.m.n.)  
sf == 0      sf == 1  
(1.m+28.n) (1.m+16.n+12)      **QPX** = DY1(R22)\*DZ2(IR3)  
                  - DZ1(R33)\*DY2(IR2); <1>  
(1.m+28.n) (1.m+16.n+12)      **QPY** = DZ1(R33)\*DX2(IR1)  
                  - DX1(R11)\*DZ2(IR3); <2>  
(1.m+28.n) (1.m+16.n+12)      **QPZ** = DX1(R11)\*DY2(IR2)  
                  - DY1(R22)\*DX2(IR1); <3>  
(1.m .n) (1.m .n )      IR1 = ImA1S(OPX);  
(1.m .n) (1.m .n )      IR2 = ImA2S(OPY);  
(1.m+16.n) (1.m+16.n )      IR3 = ImA3S(OPZ);  
(1.m+16.n) (1.m+16.n )      **MAC1** = OPX;  
(1.m+16.n) (1.m+16.n )      **MAC2** = OPY;  
(1.m+16.n) (1.m+16.n )      **MAC3** = OPZ;

### Referenced registers:

Referenced registers:		Control	Data	Control
0	VX0.VY0	R11.R12	VX0.VY0	R11.R12
1	VZ0	R13.R21	VZ0	R13.R21
2	VX1.VY1	R22.R23	VX1.VY1	R22.R23
3	VZ1	R31.R32	VZ1	R31.R32
4	VX2.VY2	R33.	VX2.VY2	R33.
5	VZ2	TRX	VZ2	TRX
6	RGB_CODE	TRY	RGB_CODE	TRY
7	OTZ	TRZ	OTZ	TRZ
8	IR0	L11.L12	IR0	L11.L12
9	IR1	L13.L21	IR1	L13.L21
10	IR2	L22.L23	IR2	L22.L23
11	IR3	L31.L32	IR3	L31.L32
12	SX0.SY0	L33.	SX0.SY0	L33.
13	SX1.SY1	RBK	SX1.SY1	RBK
14	SX2.SY2	QBK	SX2.SY2	QBK
15	SX2P.SY2P	BBK	SX2P.SY2P	BBK
16	SZx(0)	LR1.LR2	SZx(0)	LR1.LR2
17	SZ0(1)	LR3.LQ1	SZ0(1)	LR3.LQ1
18	SZ1(2)	LQ2.LQ3	SZ1(2)	LQ2.LQ3
19	SZ2(3)	LB1.LB2	SZ2(3)	LB1.LB2
20	RO.Q0.B0	LB3.	RO.Q0.B0	LB3.
21	R1.Q1.B1	RFC	R1.Q1.B1	RFC
22	R2.Q2.B2	QFC	R2.Q2.B2	QFC
23	BFC		BFC	
24	MAC0	OFX	MAC0	OFX
25	MAC1	OPY	MAC1	OPY
26	MAC2	H.	MAC2	H.
27	MAC3	DQA.	MAC3	DQA.
28	IRGB	DQB	IRGB	DQB
29	ORG	ZSF3.	ORG	ZSF3.
30	DATA32	ZSF4.	DATA32	ZSF4.
31	LZC	FLAG	LZC	FLAG

### Modified registers:

Modified registers:		Control	Data	Control
0	VX0.VY0	R11.R12	VX0.VY0	R11.R12
1	VZ0	R13.R21	VZ0	R13.R21
2	VX1.VY1	R22.R23	VX1.VY1	R22.R23
3	VZ1	R31.R32	VZ1	R31.R32
4	VX2.VY2	R33.	VX2.VY2	R33.
5	VZ2	TRX	VZ2	TRX
6	RGB_CODE	TRY	RGB_CODE	TRY
7	OTZ	TRZ	OTZ	TRZ
8	IR0	L11.L12	IR0	L11.L12
9	IR1	L13.L21	IR1	L13.L21
10	IR2	L22.L23	IR2	L22.L23
11	IR3	L31.L32	IR3	L31.L32
12	SX0.SY0	L33.	SX0.SY0	L33.
13	SX1.SY1	RBK	SX1.SY1	RBK
14	SX2.SY2	QBK	SX2.SY2	QBK
15	SX2P.SY2P	BBK	SX2P.SY2P	BBK
16	SZx(0)	LR1.LR2	SZx(0)	LR1.LR2
17	SZ0(1)	LR3.LQ1	SZ0(1)	LR3.LQ1
18	SZ1(2)	LQ2.LQ3	SZ1(2)	LQ2.LQ3
19	SZ2(3)	LB1.LB2	SZ2(3)	LB1.LB2
20	RO.Q0.B0	LB3.	RO.Q0.B0	LB3.
21	R1.Q1.B1	RFC	R1.Q1.B1	RFC
22	R2.Q2.B2	QFC	R2.Q2.B2	QFC
23	BFC		BFC	
24	MAC0	OFX	MAC0	OFX
25	MAC1	OPY	MAC1	OPY
26	MAC2	H.	MAC2	H.
27	MAC3	DQA.	MAC3	DQA.
28	IRGB	DQB	IRGB	DQB
29	ORG	ZSF3.	ORG	ZSF3.
30	DATA32	ZSF4.	DATA32	ZSF4.
31	LZC	FLAG	LZC	FLAG

**GPF sf1** Required cycles: 5

Function: General purpose Interpolation

Items specified using arguments:

Argu ment	Specified content	Value =0	Value=1
s <sup>f</sup>	Output format	-	Performs calculations on data shifted 12 bits to the left in the IRn register.

Calculations: : (m and n request the data format of IRp(p=1,2,3) as (1.m.n))

```

sf == 0      sf == 1
(1.m+28.n)  (1.m+16.n+12)  IPX = IR0*IR1; <1>
(1.m+28.n)  (1.m+16.n+12)  IPY = IR0*IR2; <2>
(1.m+28.n)  (1.m+16.n+12)  IPZ = IR0*IR3; <3>
(1.m .n)    (1.m .n)    IR1 = IRmA1S(IPX);
(1.m .n)    (1.m .n)    R2 = IRmA2S(IPY);
(1.m .n)    (1.m .n)    IR3 = IRmA3S(IPZ);
(1.m+16.n)  (1.m+16.n)  MAC1 = IPX;
(1.m+16.n)  (1.m+16.n)  MAC2 = IPY;
(1.m+16.n)  (1.m+16.n)  MAC3 = IPZ;

```

Referenced registers:		Modified registers:	
	Data		Control
0	VX0.VY0	R11.R12	0
1	VZ0	R13.R21	1
2	VX1.VY1	R22.R23	2
3	VZ1	R31.R32	3
4	VX2.VY2	R33.	4
5	VZ2	TRX	5
6	RQB	CODE	6
7	OTZ	TRZ	7
8	IR0	L11.L12	8
9	IR1	L13.L21	9
10	IR2	L22.L23	10
11	IR3	L31.L32	11
12	SX0.SY0	L33.	12
13	SX1.SY1	RBK	13
14	SX2.SY2	QBK	14
15	SX2P.SY2P	BBK	15
16	SZx0	LR1.LR2	16
17	SZ0(1)	LR3.LQ1	17
18	SZ1(2)	LQ2.LQ3	18
19	SZ2(3)	LB1.LB2	19
20	R0 Q0 B0	LB3.	20
21	R1 Q1 B1	RFC	21
22	R2 Q2 B2	QFC	22
23	BFC	BFC	23
24	MAC0	OFX	24
25	MAC1	OPY	25
26	MAC2	H.	26
27	MAC3	DQA.	27
28	IRQB	DQB	28
29	ORQB	ZSF3.	29
30	DATA32	ZSF4.	30
31	LZC	FLAG	31

Referenced registers:		Modified registers:	
	Data		Control
0	VX0.VY0	R11.R12	0
1	VZ0	R13.R21	1
2	VX1.VY1	R22.R23	2
3	VZ1	R31.R32	3
4	VX2.VY2	R33.	4
5	VZ2	TRX	5
6	RQB	CODE	6
7	OTZ	TRZ	7
8	IR0	L11.L12	8
9	IR1	L13.L21	9
10	IR2	L22.L23	10
11	IR3	L31.L32	11
12	SX0.SY0	L33.	12
13	SX1.SY1	RBK	13
14	SX2.SY2	QBK	14
15	SX2P.SY2P	BBK	15
16	SZx0	LR1.LR2	16
17	SZ0(1)	LR3.LQ1	17
18	SZ1(2)	LQ2.LQ3	18
19	SZ2(3)	LB1.LB2	19
20	R0 Q0 B0	LB3.	20
21	R1 Q1 B1	RFC	21
22	R2 Q2 B2	QFC	22
23	BFC	BFC	23
24	MAC0	OFX	24
25	MAC1	OPY	25
26	MAC2	H.	26
27	MAC3	DQA.	27
28	IRQB	DQB	28
29	ORQB	ZSF3.	29
30	DATA32	ZSF4.	30
31	LZC	FLAG	31

### GPL sf

### Required cycles: 5

Function: General purpose interpolation

Items specified using arguments:

Argument	Specified content	Value = 0	Value = 1
sf	Output format	-	Performs calculations on data shifted 12 bits to the left in the IRn register.

Calculations: : (m and n request the data format of IP(p=1,2,3)

as (1.m.n.)

```

sf == 0      sf == 1
(1.m+28.n)  (1.m+16.n+12)  IPX = MAC1 + IR0*IR1; <1>
(1.m+28.n)  (1.m+16.n+12)  IPY = MAC2 + IR0*IR2; <2>
(1.m+28.n)  (1.m+16.n+12)  IPZ = MAC3 + IR0*IR3; <3>
(1.m .n)    (1.m .n )    IR1 = lImA1S(IPX);
(1.m .n)    (1.m .n )    IR2 = lImA2S(IPY);
(1.m .n)    (1.m .n )    IR3 = lImA3S(IPZ);
(1.m+16.n)  (1.m+16.n )   MAC1 = IPX;
(1.m+16.n)  (1.m+16.n )   MAC2 = IPY;
(1.m+16.n)  (1.m+16.n )   MAC3 = IPZ;

```

```

( . . )    CD0 <- CD1 <- CODE
(0. 0. 8)  R0 <- R1 <- R2 <- lImB1(IPX);
(0. 0. 8)  G0 <- G1 <- G2 <- lImB2(IPY);
(0. 0. 8)  B0 <- B1 <- B2 <- lImB3(IPZ);

```

### Referenced registers:

Modified registers:	
	Control
0	VX0.VY0
1	VZ0
2	VX1.VY1
3	VZ1
4	VX2.VY2
5	VZ2
6	RGB <del>CODE</del>
7	OTZ
8	IR0
9	IR1
10	IR2
11	IR3
12	SX0.SY0
13	SX1.SY1
14	SX2.SY2
15	SX2P.SY2P
16	SZx(0)
17	SZ0(1)
18	SZ1(2)
19	SZ2(3)
20	R0 Q0 B0
21	R1 Q1 B1
22	R2 Q2 B2
23	BFC
24	MAC0 QFX
25	MAC1 QPY
26	MAC2 H.
27	MAC3 DQA.
28	IRGB DQB
29	ORG B ZSF3.
30	DATA32 ZSF4.
31	LZC FLAG

Referenced registers:	
	Control
0	VX0.VY0
1	VZ0
2	VX1.VY1
3	VZ1
4	VX2.VY2
5	VZ2
6	RGB CODE
7	OTZ
8	IR0
9	IR1
10	IR2
11	IR3
12	SX0.SY0
13	SX1.SY1
14	SX2.SY2
15	SX2P.SY2P
16	SZx(0)
17	SZ0(1)
18	SZ1(2)
19	SZ2(3)
20	R0 Q0 B0
21	R1 Q1 B1
22	R2 Q2 B2
23	BFC
24	MAC0 QFX
25	MAC1 QPY
26	MAC2 H.
27	MAC3 DQA.
28	IRGB DQB
29	ORG B ZSF3.
30	DATA32 ZSF4.
31	LZC FLAG





